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**DoD Supply Chain Implications of Radio Frequency Identification
(RFID) Use Within Air Mobility Command (AMC)**

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December 2003**

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**DOD SUPPLY CHAIN IMPLICATIONS OF RADIO FREQUENCY
IDENTIFICATION (RFID) USE WITHIN
AIR MOBILITY COMMAND (AMC)**

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Use Within Air Mobility Command (AMC)**

ABSTRACT

The purpose of this MBA project is to identify the existing and potential value of Radio Frequency Identification (RFID) use in the operations of Headquarters Air Mobility Command (AMC) and its worldwide network of aerial ports. The project seeks to determine how the applications of RFID within AMC can add value to AMC's operations and the operations of other DoD supply chain members. In doing so, the project describes the technical attributes of DoD's RFID tags and infrastructure, AMC's legacy Automated Information System (AIS) known as Global Air Transportation Execution System (GATES), and AMC's role within its supply chain. The project includes a discussion of potential AMC and DoD supply chain RFID applications and resulting potential value. Ultimately, the project offers a process for creating a robust RFID infrastructure.

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LIST OF ABBREVIATIONS, ACRONYMS, AND SYMBOLS

ACA	Air Clearance Authority
AFB	Air Force Base
AIS	Automated Information System
AIT	Automated Information Technology
AMC	Air Mobility Command
APOD	Aerial Port of Debarkation
APOE	Aerial Port of Embarkation
ATCMD	Advanced Transportation Control and Movement Document
ATOC	Air Terminal Operations Center
C2	Command and Control
CAPS II	Consolidated Aerial Port System II
CCP	Cargo Consolidation Point
CEDI	Commercial Electronic Data Interchange System
CENTCOM	Central Command
CMOS	Cargo Movement Operations System
CONOPS	Concept of Operations
CONUS	Continental United States
CRAF	Civil Reserve Air Fleet
DAASC (DAAS)	Defense Automatic Addressing System Center
DDJC	Defense Distribution Depot San Joaquin, California
DOD	Department of Defense
DSS	Distribution Standard System
DTRACS	Defense Transportation Recording and Control System
DTS	Defense Transportation System
EMTF	Expeditionary Mobility Task Forces
FACTS	Financial and Air Clearance Transportation System
GATES	Global Air Transportation Execution System
GDSS	Global Decision Support System
GPS	Global Positioning System
GTN	Global Transportation Network
HQAMC	Headquarters Air Mobility Command
INCONUS	In Continental United States
IRDD	Interface Requirements Design Document
ITU	International Telecommunication Union
ITV	In-Transit Visibility
JSRCIC	Joint RFID Supply Chain Implementation Committee
JTAV	Joint Total Asset Visibility
MAC	Military Airlift Command
MIT	Massachusetts Institute of Technology

MSC	Military Sealift Command
MTMC	Military Traffic Management Command
NCC	Network Control Center
OCONUS	Outside Continental United States
OMC	Optical Memory Card
PACOM	Pacific Command
POD	Port of Debarkation
POE	Port of Embarkation
RF	Radio Frequency
RFID	Radio Frequency Identification
RITV	Regional In-Transit Visibility
SAC	Strategic Air Command
TACC	Tanker Airlift Control Center
TACC	Tanker Airlift Control Center
TAV	Total Asset Visibility
TC-AIMS II	Transportation Coordinator's Automated Information Movement System
TCC	Transportation Command Components
TCN	Transportation Control Number
UCC	Uniform Code Council
USD	Under Secretary of Defense
USTRANSCOM	United States Transportation Command
WPS	Worldwide Port System

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FOREWORD

The authors hope that this project will stimulate thought with respect to the processes that occur within and between each link of the DoD supply chain. A related consideration is how these processes, as they currently exist, may not be congruent with DoD's plan for broad RFID tag and infrastructure implementation into its supply chain. Considering the amount of commercial and DoD research into the topic, it is quite possible that some of the recommendations outlined in this project have already been proposed in commercial and DoD Automated Information System (AIS) and Automated Identification Technology (AIT) developmental circles, unbeknownst to the project's authors. If nothing else, this research should support the argument that RFID should play a larger role in the DoD supply chain.

Neither of the authors professes expertise in the intricacies of the Air Mobility Command or DoD supply chain. It is our hope that any errors in research and shortcomings in experience do not diminish the reader's careful consideration of the project's recommendations.

The project team recommends that readers who are familiar with RFID, Air Mobility Command cargo handling processes and the Global Air Transportation Execution System proceed to chapters six, seven and eight. The initial five chapters of the project serve as primers for readers who are unfamiliar with these topics.

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5 December 2003

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I. RADIO FREQUENCY IDENTIFICATION (RFID) TECHNOLOGY PRIMER

A. RFID: DEFINITION, COMPONENTS AND CONCEPT OF OPERATION

In the simplest terms, an RFID system consists of an antenna, a transceiver (with decoder), and a transponder (RF tag) electronically programmed with information unique to the tag. The antenna is designed to emit radio signals that activate the tag and have the ability to read and, in some cases, write data to it. Antennae form an electromagnetic channel between the tag and the transceiver, the execution device for data acquisition and communication. The electromagnetic field produced by the tag's antenna can be constantly present or can be activated by a sensor (interrogator) device at the desired frequency.

The transceiver is designed to read and write data onto the tags. The decoder is used to translate the information sent and received from tags to the transponders. Often, transceivers are packaged with the antenna in the form of either a handheld or a fixed-mount device. The transceiver and antenna together, in conjunction with the decoder, form a reader that can emit radio waves in ranges of anywhere from one inch to one hundred feet or more, depending upon its power output and the radio frequency used. When the RFID tag passes through an area where the electromagnetic field is active, the reader's activation signal is detected and the tag begins communicating with the reader. The decoded data gathered by the reader is then passed to an RFID server that feeds the Global Transportation Network, making it available to the end user. This process will be elaborated upon in later sections.

RFID tags have a wide variety of shapes and sizes. The type of tags that is used in a given logistical application ideally depends on the requirement of the transporters and the end users. Examples of these how the varied shapes and sizes of tags used are determined by the users' requirements include small tags that are attached to animals for tracking purposes, credit-card shaped tags for use in access applications, anti-theft hard plastic tags attached to merchandise in stores, and large rectangular transponders that can

be used to track intermodal containers or heavy machinery.¹ The information that tags can provide is only limited by tag memory space, which in its current form is already significant. The memory of RFID tags varies. Tags currently exist with memories as high as 1MB.

Applications for RFID use can be identified in virtually every sector of every industry. Any activity that benefits or could benefit from data collection stands to potentially benefit from RFID, although doing so may currently be cost prohibitive in small budget operations. Although there are other data collection technologies that are already available at lower cost than RFID, RFID has unique competitive advantages that make it a good complement or replacement for other Automated Information Technology (AIT) media such as bar codes or optical devices. These devices and their differences from RFID will be discussed in more detail in subsequent sections.

B. RFID WIRELESS COMMUNICATION AND CARRIER FREQUENCIES

The primary advantage of RFID technology over other AITs is the absence of wire or line of sight requirements for successful communication between the tag and the reader. From the communication perspective, two different methods are used for communicating with the RFID tags. The first one is based on close proximity to electromagnetic fields or inductive coupling whereas the other is based on propagating electromagnetic waves.

Although the absence of wires or line of sight requirements for communication with the tags is an advantage, it also represents a risk. The medium through which the tags and transceivers communicate is air, and the transmission is omnidirectional. Thus, the transmission is vulnerable to noise and distortion that can corrupt the information received. It is also a security concern in that anyone with a reader has the potential to be able to receive information from active RFID tags within the range of the particular reader. Another issue that arises with RFID is the frequency allocation, a concern that does not impact line of sight AITs such as barcodes. The differentiation in frequencies can be a limiting factor in that certain countries have already allocated generally accepted RFID frequencies for other uses in their respective countries. The switching costs

¹ "What is Radio Frequency Identification (RFID)?"
[www.aimglobal.org/technologies/rfid/what_is_rfid.htm], 27 November 2003.

associated with restricting for RFID those frequencies being used for other applications would be enormous. Although there are technical workarounds being devised for this and other compatibility issues, frequency allocation remains one of the roadblocks to worldwide RFID standardization.

Currently, each country allocates its own frequencies based on the regions under which they fall within the international frequency guidelines. In doing so, they are required to comply with the regulations prescribed by the International Telecommunication Union (ITU) to “avoid mutually harmful interference between neighbouring countries.”² These regions include Europe and Africa (Region 1), North and South America (Region 2) and Far East and Australasia (Region 3).³ However, there has been little consistency over time regarding frequencies utilization. This constraint creates an obstacle in implementing RFID use by DoD on a global scale outside of DoD organic infrastructures.

There are three frequency ranges commonly used for identification purposes: low, intermediate and high. Each one has specific applications to which it is best suited. Table 1 summarizes these three frequency ranges, their system characteristics and some of the typical areas of application.⁴

² “Compliance With Internationally Accepted Methods,” [http://iba.org.za/frcompli.htm], 2 December 2003.

³ “Region 1 - Europe, Africa and Northern Asia,” [http://www.scnt01426.pwp.blueyonder.co.uk/Articles/Bandplan/Region1.htm], 02 December 2003.

⁴ “RFID, a Basic Primer,” [www.aimglobal.org/technologies/rfid/resources/papers/rfid_basics_primer.htm], 27 November 2003.

Frequency Band	Characteristics	Typical Applications
Low 100-500 kHz	Short to medium read range Inexpensive Slow Reading Speed	Access control Animal identification Inventory control Car immobilizer
Intermediate 10-15 MHz	Short to medium read range Potentially Inexpensive Medium Reading Speed	Access control Smart cards
High 850-950 MHz 2.4-5.8 GHz	Long read range High reading speed Line of sight required (hifreq) Expensive	Railroad car monitoring Highway toll collection systems

Table 1. Common Automated Identification Frequency Ranges

C. RFID MODES OF OPERATION

1. Active

RFID tags can be generally categorized as active or passive. Active RFID tags are powered by an internal battery, have their own memory and are typically read/write capable. This capability is advantageous in supply chain activities such the transportation of containers whose cargo changes from port to port. A history record can be written onto a tag and then modified or updated when the contents of the sea van are offloaded and new ones are on loaded. The battery-supplied power gives the tag longer read range, which can be important in an industrial environment in which many containers find themselves. Active tags have some disadvantages: greater size, greater cost (SAVI active tags used by DoD are \$99), and a limited operational life (maximum of 10 years, but often much shorter depending upon operating temperatures and battery type).⁵

2. Passive

Passive tags obtain operating power by inducing power from the signal sent by the tag reader (antenna). The fact that the power comes from an external source makes passive tags less expensive. It also removes the constraint of battery life when

⁵ "What is Radio Frequency Identification (RFID)?"
[www.aimglobal.org/technologies/rfid/what_is_rfid.htm], 27 November 2003.

considering the life of the tag, which becomes virtually unlimited. Passive tags are typically read-only after the initial data is written onto them. They are able to be programmed with a unique set of data (usually 32 to 128 bits) that cannot be modified. In this sense, the operational concept of passive tags can be compared with linear barcodes. However, there is a significant difference. RFID provides much greater flexibility in being able to gather data from a tag located anywhere within the range of an RFID reader whereas barcodes must be manually scanned with a handheld reader or passed over a barcode reader. The primary disadvantage of passive tags in comparison to active ones is the lower read range and the requirement of higher-powered readers to power the tag in order to enable it to emit a signal.⁶

D. RFID ADVANTAGES AND DISADVANTAGES VERSUS OTHER AIT MEDIA

RFID technology is one element of a group of media called Automatic Identification Technology. It is important to understand at this point that RFID and other AITs are not systems to be used as a panacea for supply chain visibility and problem solving. They can, however, serve as supporting technologies for legacy Automated Identification Systems (AISs) and new ways of supply chain thinking (i.e., new chain processes). To this extent, it is advantageous to analyze the advantages of RFID compared with other, cheaper media that make up the family of AITs (bar codes, optical devices, etc.). As previously mentioned, contrary to other systems, RFID does not require line of sight contact with the target to be read or scanned. RFID tags allow robust performance in adverse conditions such as sand, snow, fog, ice, paint, crusted grime, and other visually and environmentally challenging conditions where other AIT media can become useless.⁷ One ping from an RFID interrogator can result in a response from thousands of RFID tags, each of which respond in less than 100 milliseconds from the time they were pinged. This speed versus the time it takes to manually scan a bar code multiplied by potentially thousands of barcodes to individually scan clearly demonstrates the advantage of RFID in the real time inventory-tracking arena. As previously mentioned, the active tag's read/write capability provides advantages over other AITs in

⁶ Ibid.

⁷ Ibid.

scenarios requiring interactive application (especially work-in-process or maintenance tracking) where other AITs may not be as easily integrated or provide the speed that RFID can provide.

There are, however, disadvantages to RFID technology. As cheap as the passive tags are (currently between 25 and 35 cents), the requirement for active tags remains and their cost is still significant.⁸ The most obvious current disadvantage (compared to other AIT media) is the high cost (\$99 for active tags versus virtually nothing for bar code imprinting, infrastructure considerations aside). However, RFID's use in the commercial and defense sectors is becoming more widespread, thus the prices for tags and infrastructure should eventually decline to the point where additional tags can be affixed to individual items for even better visibility granularity.⁹ Ultimately price will become much less of a constraint for many users, including DoD.

Another disadvantage is the previously mentioned lack of a robust worldwide DoD and commercial RFID infrastructure. This creates large gaps in the ability of activities to accurately track their cargo through the supply chain. Putting tags on everything serves no purpose if the infrastructure with which to read them is insufficient. For the moment, gaps in RFID visibility caused by limited RFID infrastructure have had relatively little impact on DoD operations. There are enough legacy logistics systems to make up for most of the losses of movement information. These gaps, however, are a severe constraint in enhancing the ability of supply chain planners and operators to use RFID to maximize the potential efficiencies that exist in the supply chain but have not yet been exploited. Using RFID to make the supply chain more efficient, however, will require end-to-end RFID reading and writing ability. The potential benefits of a robust RFID infrastructure will be elaborated upon in Chapters 7 and 8.

⁸ "Sensors and Nets," [<http://www.telematica.com/blog/categories/sensorsAndNets/2003/08/25.html>], 2 December 2003.

⁹ Hachman, Mark, "DoD Details its RFID Plans," [http://www.eweek.com/print_article/0,3048,a=110899,00.asp], 2 December 2003.

II. CONCEPT OF AUTOMATED IDENTIFICATION TECHNOLOGY (AIT) IMPLEMENTATION

A. INTRODUCTION

The purpose of this chapter is to analyze the concept of how DoD's initial plan to incorporate AITs into its logistics pipeline. Additionally, this chapter will describe in detail three competing and complementing Automatic Identification Technologies. This chapter will provide to readers not familiar with forms of AITs other than RFID a better understanding of the capabilities of other AITs.

B. BACKGROUND

In January 1997, the Deputy Under Secretary of Defense for Logistics and Materiel Readiness (DUSD (L&MR)) approved the establishment of a DoD Logistics AIT Task Force. This group had the specific mission of developing a logistics AIT Concept of Operations (CONOPS).¹⁰ The group came up with an AIT Operational Prototype, which was approved to be tested in April 1997. The test of this prototype was performed by the AIT Integrated Process Team (IPT), the group who succeeded the initial AIT Task Force, from May 1998 through February 1999, using European (U.S. Forces returning from Bosnia) and CONUS mobilization scenarios as a framework for their AIT prototype implementation.

The AIT prototype was operationally tested in three different scenarios, air cargo movement, commercial sea van shipping, and military unit movements. An analysis was completed of the potential costs and benefits of implementing different AITs within each of these DoD logistical arenas. The focus of the test was to identify potential productivity enhancements (e.g., labor efficiencies gained, better shipping and inventory accuracy, and information timeliness).

C. AIT CONCEPT OF OPERATIONS (CONOPS)

The AIT Concept of Operations (CONOPS) was ultimately approved in November 1997 by the Under Secretary of Defense for Acquisition and Technology (USD (A&T)). The CONOPS had two major implications on the implementation of AIT.

¹⁰ Deputy Under Secretary of Defense (L&MR), Automatic Identification Technology Task Force, 7 January 1997.

First, it served as a standard upon which DoD AIT policy for logistics operations could be developed. Secondly, it established timeliness criteria for inputting critical asset visibility data into logistics AISs in order to ensure that the information available to logistics decision makers and customers was as close to real-time and thus, useful, as possible. The CONOPS outlined the following key elements:

1. AIT Vision

The CONOPS envisioned AIT as a “toolbox” for commanders and logistics operators with the ability to provide a mix of media technologies that would allow users to efficiently and effectively capture, aggregate, and transfer data and information. It was also envisioned that the AIT would integrate with legacy DoD logistical AISs (Automated Information Systems) using the appropriate AIT media for each particular application. According to the CONOPS, AIT would facilitate data collection and flow to all AISs to better achieve both full ITV (In-Transit Visibility) and TAV (Total Asset Visibility), capabilities that would, in turn, enhance and streamline business processes and war-fighting capabilities.¹¹

2. Principles of AIT

The CONOPS also provided the following overarching principles to guide DoD’s application of AIT to its logistics processes:¹²

- “AIT should transfer data directly to the appropriate AIS to the maximum extent practicable. AIT should maximize the use of pre-positioned data and minimize the level of human intervention to collect and transfer data to AIS.”
- “The application and fielding of AIT should be compatible throughout all DoD logistics functions and commercial distribution business processes that support the DoD logistics pipeline.”
- “AIT decisions should be based on specific user requirements for accurate and timely data, process improvement, and enhanced war-fighting capability.”

¹¹ Under Secretary of Defense (A&T), DoD Plan for Logistics Automatic Identification Technology Implementation, 17 March 2000.

¹² Ibid.

3. Logistics Data Timeliness Criteria

A set of data timeliness criteria was established to ensure that logistics activities were feeding data into the RFID system at a frequency that would allow commanders and logistics managers to make decisions based on logistical information that was as close to being real time as was practical. The CONOPS established the following time criteria for presenting that data:¹³

- One hour for all shipments of unit and non-unit equipment.
- One hour for all air shipments.
- Four hours for all ocean surface shipments.
- Two hours for all intra-theater shipments.

4. CONOPS Framework

The CONOPS emphasized that only AIT devices that provide value to logistics processes were to be utilized. The device utilization plan followed the general policy stated below:¹⁴

- Bar codes should be used to collect initial source data and applied to all items and shipments moving throughout the logistic chain.
- OMC (Optical Memory Card) is the preferred choice of AIT for sending large amounts of data to AISs when the investment generates sufficient savings in receipt processing time or increased accuracy.
- RFID should be used in any of the following situations:
 - When a user needs to be able to locate and redirect shipments
 - When a user requires visibility of container contents
 - When inadequate systems or communications infrastructure prevent the capture and timely transfer of asset visibility data.
- Satellite-tracking systems should be used to track the location of vehicles and convoys in near real-time.

¹³ Ibid.

¹⁴ Ibid.

D. AIT MEDIA AND SUPPORTING TECHNOLOGIES¹⁵

In order to be able to later clarify why RFID is such an attractive option in many logistics scenarios, we will describe the different AITs and their role in the operational test of the 1998-9 AIT prototype.

1. Bar Codes

A bar code is a small set of lines printed on a tag, label, or box that represent different characters. They are often found printed directly onto a box or onto a plastic tag that can be affixed adhesively to a box or piece of cargo. The characters represented by the bar code correspond to a certain item in a database. A reader, either handheld or mounted, is required to scan and send the information to a server that has access to a database. The information on the code is matched to the database to determine what was actually scanned. This decoded information is sent to the host AIS. Currently, two types of bar codes are used, linear and 2D (two dimensional). Linear bar codes are best suited to simple identification of items as well as providing document control information for individual items and shipments. 2D bar codes are able to provide more than the simple, unique code capability of linear bar codes. Imbedded within the 2D code can be multiple codes for multiple uses.

Although the utilization of bar codes is a widely accepted AIT, its performance during the operational prototype was not completely successful. An analysis of the results of the test found that approximately 10 percent of linear bar codes and 20 percent of 2D bar codes were unreadable to aerial port operations due to various reasons. Culprits for rendering tags unreadable included poor bar code print quality, smears, poor contrast, improper label stock, incorrect ink, and poor printer adjustment.”¹⁶ Human factors also were responsible for failures in being able to read bar codes. People unaware of the importance of the tag could “unintentionally obscure bar codes by placing checks, circles, or underlining data on labels or by covering the bar code with another label.”¹⁷ Other factors that affected the reading of bar codes included the ability of the operators to correctly scan bar codes as well as the reliability of the scanning equipment.

¹⁵ Ibid.

¹⁶ Ibid.

¹⁷ Ibid.

2. Optical Memory Cards (OMC)

The technology used by OMC is based on the principle of reflectivity, where data are etched to the card using a high-intensity laser and recovered by a light beam. This is the same technology used in audio compact discs, DVD and audio-visual CD-ROMs (read only memory). This supporting AIT is particularly practical when the amount of information required to be burned onto the card requires significant memory and will be read many times by different entities after being recorded. OMCs containing a detailed manifest of the cargo routinely accompany air pallets, trucks, and sea van containers between selected depots and supply support activities. The principal advantages of the OMC are its low cost, its capacity to storage large amount of data, its reusable nature and its relative stability to climatic variations.

The operational test findings of the OMC element in the aforementioned AIT prototype test resulted in mixed reviews. One positive outcome of the test was that the portable nature of OMCs provided the cargo handling elements of the test with an effective way to transfer data from one AIS to another when network AIS-to-AIS interface was not available. There were, however, disadvantages associated with the use of OMC. First, the data between port of embarkation (POE) and port of debarkation (POD) were already being transferred electronically using either the Consolidated Aerial Port System II (CAPS II) for air pallets or the Worldwide Port System (WPS) for sea-van containers, thus OMC was redundant and added no value in this area.¹⁸ Secondly, although shipments arrived already consolidated to APOEs (aerial port of embarkation), they were subsequently unpalletized and repalletized depending on the destination of the cargo making up the pallets. This requirement resulted in worthless OMCs due to the impracticality of altering the data originally burned onto the OMC.

3. Satellite Tracking Systems

A typical DoD satellite-tracking system for trailers or containers is composed of five parts: a transceiver unit, a satellite, an earth station, a vendor network control center (NCC), and a DoD logistics AIS. The transceiver that is installed in a moving vehicle

¹⁸ CAPS II was replaced by the Global Air Transportation Execution System (GATES) at all programmed sites by November 1999.

exchanges data with an earth station using a satellite. Earth stations are connected to the NCC, and the NCC is connected to a specific DoD server that is able to download on a continuous basis the information kept in special NCC mailboxes. Commercial satellite-tracking systems are designed to track near real-time location of vehicles, materiel, and convoys and also offer a digital communication capability to drivers. The primary disadvantage to the satellite tracking system is that it requires an unobstructed line of sight to the tracking satellites. Thus, for pallets that are being held within a warehouse, as far as GPS is concerned, they are invisible and cannot be “pinged” to determine their whereabouts. Satellite tracking was determined to be a useful AIT when ITV tracking between supply chain nodes was required.

III. JOINT TOTAL ASSET VISIBILITY (JTAV) AND THE GLOBAL TRANSPORTATION NETWORK (GTN)

A. JOINT TOTAL ASSET VISIBILITY CONCEPT AND DEFINITION

The concept of Joint Total Asset Visibility (JTAV) is to provide to its users timely and accurate information on the location, movement, status, and identity of units, personnel, equipment, and supplies across components.¹⁹ JTAV does not actually “produce” data. It serves, rather, as an access point to data gathered from the legacy AISs of all of the Services. This access to total asset visibility is a fundamental first step in maximizing the efficiencies of a supply chain.

B. ORIGINS OF JTAV

One constant in every major deployment of US forces during the 20th century has been the loss of visibility of assets as they flow through the DoD supply chain. This situation has created a lack of confidence of the end users in the supply chain. This lack of confidence has, in turn, created immeasurable inefficiencies in the chain. One example of the effects of this lack of confidence is the fact that multiple requisitions are often made for one item that, in some cases, has already shipped and is somewhere in the supply chain but is invisible to the end user who, after some time, may consider it lost. In reality, the part is simply waiting on a truck to come pick it up at the aerial port of debarkation (APOD) just a few miles down the road.

An example of this problem occurred in Operations Desert Shield and Desert Storm. Over 40,000 containers were shipped to the Middle East (including \$2.7 billion worth of spare parts) of which 30,000 of them had to be opened, inventoried, resealed, and reinserted into the transportation system because personnel at the ports of debarkation (POD) did not know the contents or final consignees.²⁰ At the end of the war, “more than 8,000 containers remained to be opened” and “the contents of another 250,000 Air Force pallets could not be readily identified.”²¹ Almost all of the parts were

¹⁹ Taylor, William, MAJ, USMC, “Joint Total Asset Visibility: Foundation of Focused Logistics,” [http://www.defenselink.mil/acq/jtav/theater.pdf], 28 November 2003.

²⁰ Kennedy, Harold, “Electronic Identification Tags Aid Logistics,” [http://www.nationaldefensemagazine.org/article.cfm?Id=1180], 30 November 2003.

²¹ Taylor, William, MAJ, USMC, “Joint Total Asset Visibility: Foundation of Focused Logistics,” [http://www.defenselink.mil/acq/jtav/theater.pdf], 28 November 2003.

delivered to their respective requisitioners by the end of the war, although many logisticians mentioned after the war that this was the result of “brute force” logistics processes that were “neither efficient nor desirable.”²²

The establishment and maintaining of a system that allows logisticians in the supply chain to have complete visibility of the assets as they move through the supply chain pipeline will ultimately have significant influence on the confidence of end users in the supply chain. Repeat requisitions will be significantly reduced, thereby saving money on duplicate orders while helping to provide transportation planners, vendors, and depots with a more accurate forecast of actual demand.

C. GLOBAL TRANSPORTATION NETWORK (GTN)²³

Located in Building 1575 at Scott Air Force Base (AFB), Illinois, GTN is hosted on a group of servers connected to a dedicated GTN Local Area Network (LAN) upon which myriad legacy AISs feed information to the GTN. GTN is an automated logistics AIS information consolidator. Its function is to support C2 elements, logisticians, and end users by providing them with an integrated system of In-Transit Visibility (ITV) information based on the feeds received from the AISs of the various Services. The goal of GTN is to provide one stop shopping logistical support for transportation planning and operational decision-making during peace and war. Its scope encompasses all intra-theater, inter-theater, and INCONUS movements of cargo and personnel.

GTN supports C2 information requirements by gathering data from many AIS sources on the status of cargo both within the DTS as well as cargo being transported to a DTS supply chain link and presenting it in a single integrated view. GTN enables another degree of ITV by providing schedules and actual transportation movement information (itineraries and manifests) about units, forces, cargo, air refueling, passengers, and patients. In the realm of cargo movement, GTN collects, integrates, and displays ITV information from legacy AISs from the time the part leaves the factory to the time it arrives at the POD where often times the last mile of the logistics trail becomes difficult to follow or cold altogether. Figure 1 shows the GTN and its

²² Ibid.

²³ Lockheed Martin Mission Systems, “Interface Requirements/Design Document between GTN and RF Tag, Revision B,” 12 January 2001.

relationship with key cargo movement related legacy system feeds that serve as interfaces and/or sources of data for GTN's users.²⁴ To be consistent with the goal of this project, only the air transportation related RFID interface of GTN will be analyzed.

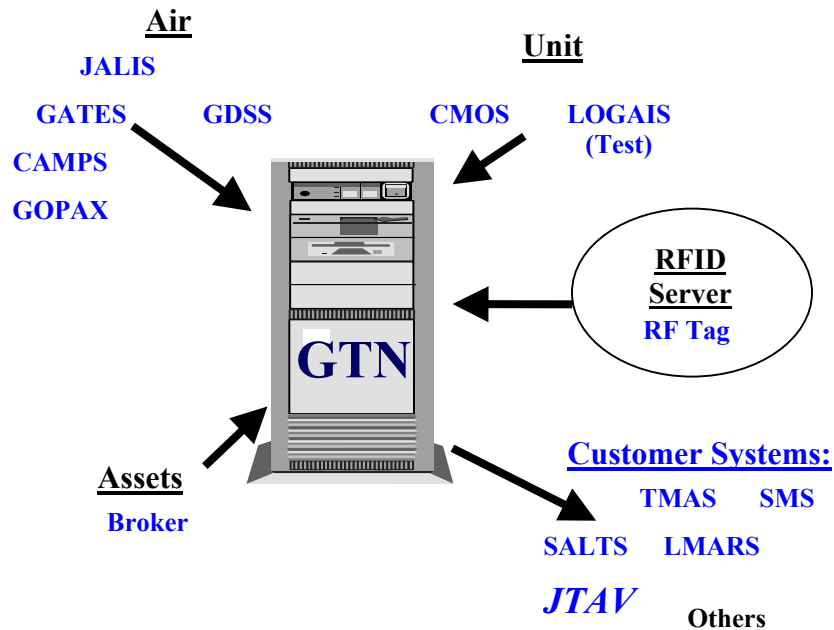


Figure 1. GTN Interfaces

D. GTN-RFID INTERFACE

There are two overseas RFID servers that track the movements of cargo labeled with RFID tags within their theaters. The two servers are located in Friedrichsfeld, Germany and Taegu, Korea. When a reader overseas interrogates a tag, the data acquired from the tag is sent to the respective RFID server serving the region in which the reader is located. These servers retransmit the data to an RFID CONUS server located in Reston, Virginia. The data from tags interrogated and read INCONUS are relayed to the CONUS server. These two avenues of feeding RFID information into the CONUS server and subsequently into GTN are depicted in Figure 2.

²⁴ GTN System Architecture Slides obtained from Scott AFB.

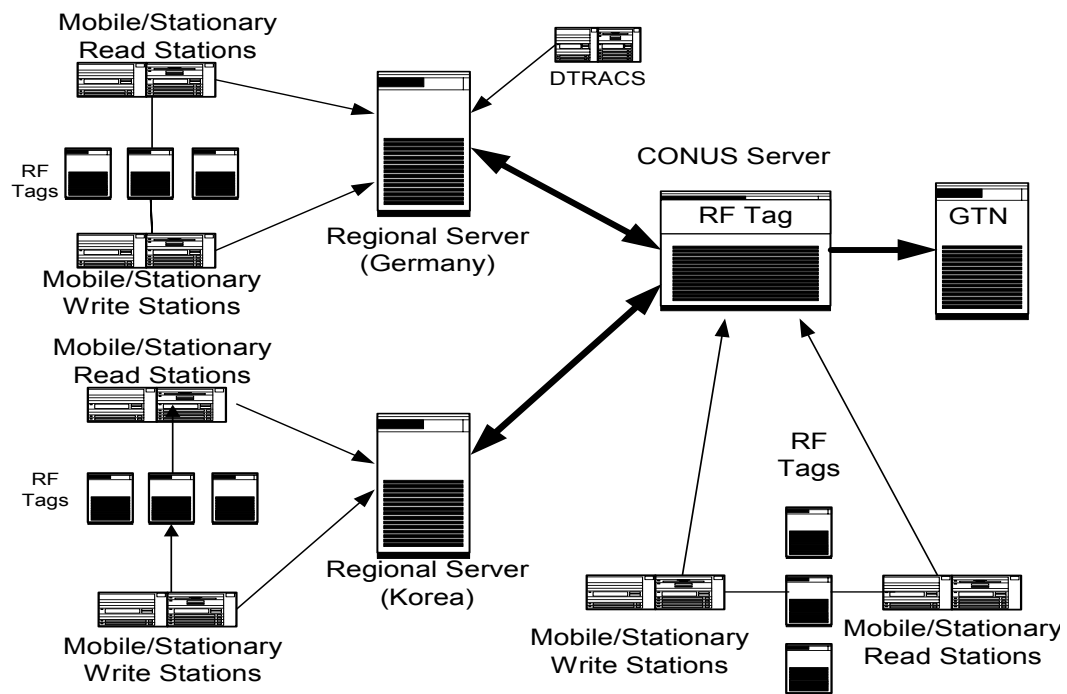


Figure 2. GTN-RFID Interface²⁵

²⁵ Lockheed Martin Mission Systems, "Interface Requirements/Design Document between GTN and RF Tag, Revision B," 12 January 2001.

IV. HEADQUARTERS AIR MOBILITY COMMAND (HQAMC) SCOTT AFB, ITS AERIAL PORTS, AND THEIR ROLES AND PROCESSES WITHIN THEIR SUPPLY CHAIN

A. INTRODUCTION

This chapter highlights the history, mission and size of AMC as well as its position within the DoD Chain of Command. It will also serve to describe the position and processes of AMC within the DoD supply chain. This chapter provides the foundation for the reader to better understand the subsequent chapters on AMC's cargo and personnel tracking systems as well as their incorporation of RFID into GTN.

B. OVERVIEW OF AMC

Air Mobility Command's primary mission is "rapid, global mobility and sustainment for America's armed forces".²⁶ Their air assets allow the United States to transport troops, their associated support equipment and cargo almost anywhere in the world. Their successful operations in the aforementioned austere regions support their success in fulfilling their mission claim. They are the sole means of the government to rapidly transport (<48 hours) cargo from CONUS to OCONUS. AMC is one of the three commands shown in Figure 3 operating under the auspices of the United States Transportation Command (USTRANSCOM), the other two being the Military Sealift Command (MSC) headquartered in Washington, DC and the Military Traffic Management Command (MTMC) headquartered at Alexandria, Virginia.

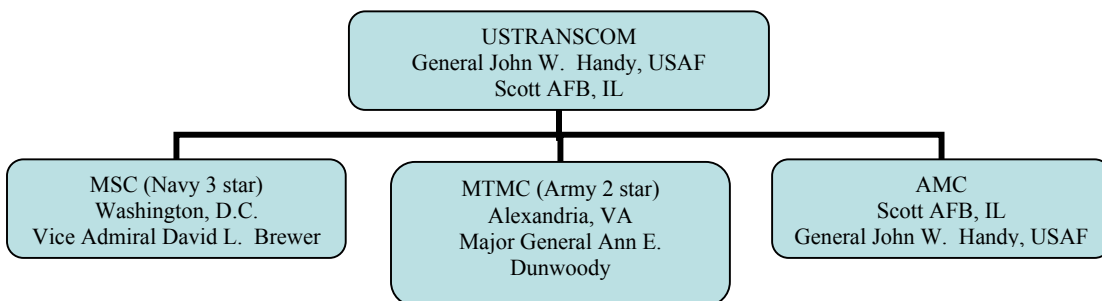


Figure 3. USTRANSCOM Hierarchy

²⁶ AMC, Office of Public Affairs, "U.S. Air Force Fact Sheet,"
[http://www.af.mil/factsheets/factsheet_print.asp?fsID=159&page=1], 30 October 2003.

1. Creation of AMC

The current structure of USTRANSCOM is a legacy of the successful coordination by USTRANSCOM of the logistical support provided by the three aforementioned Transportation Command Components (TCCs) during Operations Desert Shield and Desert Storm. Following the 1991 war, as a result of the obvious logistical benefits enjoyed by the United States during Gulf War's buildup, the Secretary of Defense gave USTRANSCOM a broader charter than the one that it had been given in 1987 after the passage of the Goldwater-Nichols Department of Defense Reorganization Act of 1986, legislation which eliminated the law prohibiting consolidating of military transportation commands.²⁷ The new charter, given on 14 February 1992, was a vast improvement over the charter of 1987 that left much of the daily operation of the TCCs out of the reach of USTRANSCOM. The new directive stated that the command's new mission would be "to provide air, land, and sea transportation for the Department of Defense, both in time of peace and time of war."²⁸ The primary difference in the new charter was the control that it gave USTRANSCOM over the TCCs during peacetime. USTRANSCOM now has control of all of the transportation assets held by the TCCs that are not specifically assigned to OCONUS theaters or those that are Service specific. The charter made the USTRANSCOM the Department of Defense's "single-manager for transportation".²⁹

2. History

Air Mobility Command came into existence on 1 June 1992. Its creation, the largest reorganization of the Air Force since its inception as a separate Service, was largely a result of the collapse of the Soviet Union and the subsequent restructuring that the evolving world order required.³⁰ AMC is the product of the combining of two Cold War Air Force commands, the Military Airlift Command (MAC) and part of the Strategic

²⁷ John Pike, "U.S. Transportation Command," [http://www.globalsecurity.org/military/agency/dod/transcom.htm], 30 October 2003.

²⁸ Ibid.

²⁹ Ibid.

³⁰ John Pike, "Air Mobility Command," [http://www.globalsecurity.org/military/agency/usaf/amc.htm], 30 October 2003.

Air Command (SAC).³¹ The airlift assets of MAC and the tanker capabilities of the SAC were a logical fit, as the assets of the SAC were no longer needed for the close monitoring of the former Soviet Union.

Throughout the 1990's, AMC played significant roles in peacekeeping missions in Bosnia, Somalia, Rwanda, Haiti and East Timor. AMC also participated in various humanitarian efforts in the former Soviet Union, Turkey, and Honduras.³² During the fall of 2001, in support of Operation Enduring Freedom that took place in response to the terrorist attacks of September 11, 2001, AMC flew 4,864 airlift missions and 2,936 air-refueling missions.³³ AMC's efforts during the buildup and combat phases Operation Iraqi Freedom in late 2002 and early 2003, efforts that are ongoing to date, have been no less Herculean. Its planes have flown enough missions to circle the earth 22,000 times, delivered enough equipment laden cargo to form a line 102 miles long, and have carried enough food to serve 59 million meals.³⁴

3. AMC Composition

As of June 2002, Air Mobility Command is composed of slightly more than 140,000 personnel worldwide of whom approximately 51,000 are active duty personnel, 40,000 are Air National Guard personnel, 44,500 are Air Reserve Component personnel, and 8,700 are commercials.³⁵ It has one numbered air force, the three-star headed 18th Air Force, headquartered at Scott AFB that stood up on 1 October 2003. The result from the creation of this new command, according to the Commander of USTRANSCOM and AMC, General Handy, will be a "single commander charged with the tasking and execution of all air mobility missions."³⁶ Reporting to the 18th are two Expeditionary Mobility Task Forces (EMTF), the 15th EMTF at Travis AFB, California and the 21st at McGuire AFB, New Jersey. The Tanker Airlift Control Center, Scott AFB, reports to the 18th as well. Also reporting to the 18th are AMC's wings and groups located INCONUS.

³¹ Headquarters AMC History Office, "Brief History of the Air Mobility Command," [http://public.amc.af.mil/library/amc_history.htm], 30 October 2003.

³² Ibid.

³³ Ibid.

³⁴ Colonel Hart, AMC, interview by authors, 8 October 2003, Scott Air Force Base, IL.

³⁵ "AMC Mission," [<http://public.amc.af.mil/about/faq.htm>], 30 Oct 2003.

³⁶ General John W. Handy, "AMC reorganizes to better serve war fighters," [<http://amcpublish.scott.af.mil/news/july/030719.htm>], 30 Oct 2003.

Two Air Mobility Operations Groups at Travis AFB and Hickam AFB, Hawaii, report to the 18th through the 15th EMTF. The other two groups at McGuire AFB and Ramstein Air Base, Germany, report to the 18th AF through the 21st EMTF.³⁷ Primary air cargo transportation assets (not including KC-135 tankers) are located at Andrews AFB (various assets), MD, Charleston AFB, SC (C-17), Dover AFB, DE (C-5), McChord AFB, WA (C-17), McGuire AFB, NJ (C-141), Pope AFB, NC (C-130), Scott AFB (C-9), and Travis AFB, CA (C-5).³⁸

AMC's footprint at Scott AFB is significant, including Headquarters Air Mobility Command and its Tanker Airlift Control Center (TACC), 18th Air Force, and 375th Airlift Wing. The 375th is primarily a support wing providing base support for USTRANSCOM, AMC, and the 18th as well as the numerous smaller entities that populate the base. As the 375th is not one of AMC's primary movers of large quantities of cargo, it will not be expanded upon in this project. An overview of the operational element of Headquarters AMC, the TACC, is outlined below.

The TACC's mission includes the responsibility for the planning, scheduling and directing of over 1400 organic AMC tanker and airlift assets, the Civil Reserve Air Fleet (CRAF), and commercially contracted assets in support of USTRANSCOM and AMC. It "provides centralized Command and Control (C2) of airlift and air refueling assets".³⁹ It is within the TACC that AMC executes its mission of worldwide transport for cargo and passengers. Missions are planned here by a team of approximately 700 people from start to finish in a modern control center laden with computers, people and screens. It became operational in April 1992 and serves the same functions of executing airlift, air refueling, aeromedical, and operational support during peace and war. TACC's ability to increase operational tempo without loss of service makes it an invaluable asset to AMC in fulfilling its mission.⁴⁰

³⁷ AMC, Office of Public Affairs, "U.S. Air Force Fact Sheet," [http://www.af.mil/factsheets/factsheet_print.asp?fsID=159&page=1], 30 October 2003.

³⁸ "AMC Mission," [http://public.amc.af.mil/about/mission.htm], 30 October 2003.

³⁹ Major Bryan Huntsman, "HQ AMC TACC Fusion Cell Charter," 30 July 2002.

⁴⁰ "Tanker Airlift Control Center," [http://www.globalsecurity.org/military/agency/usaf/tacc.htm], 30 October 2003.

Providing a clear, useful, real-time picture to TACC and AMC leadership of upcoming AMC missions, missions that have been completed as well as missions that are currently being executed is a daunting task. The responsibility of deciphering the mounds of information available on the myriad information systems feeding GTN for use by the leadership elements of AMC and TACC rests with the “Fusion Cell” division of TACC. The Fusion Cell, created in the wake of the September 11th attacks, serves a function that is not repeated in other USTRANSCOM or AMC entities. According to its charter, its specific tasks include “recovering actual mission information on AMC assets including cargo and passenger information for all AMC missions from automated systems (i.e., GTN, GDSS, GATES), comparing planned mission data to recovered actual mission information, determining ‘the true story’ and entering it into the Fusion Cell database.”⁴¹ The Fusion Cell serves as a detective for its stakeholders, uncovering “transportation system data [that] is suspicious” and subsequently performing further research by going directly to the respective Command and Control (C2) figures or the AMC Aerial Port authorities.⁴²

The Fusion Cell charter states that it is not a physical provider of ITV. Its *raison d’etre* leans more to being a provider of the total AMC picture at any given moment to its customers, the leadership of the TACC and AMC. It provides this information in daily briefs and upon request. RFID’s value to the TACC Fusion Cell in executing its mission on a daily basis will be discussed in chapter six.

C. AMC’S SPECIFIC FUNCTION IN ITS SUPPLY CHAIN

AMC’s HQ at Scott AFB and its APOE’s throughout the world have very different roles. HQ AMC, as previously mentioned, is the home of the TACC. It is the TACC that provides the Command and Control for all of AMC’s airlift and air refueling assets. AMC Scott AFB does not, however, play a significant role in the physical action of moving cargo. This responsibility falls on the APOE’s that serve as AMC’s “airports” whose air assets fall under the control of the TACC. The role of AMC in the APOE-APOD link of the DoD supply chain is, clearly, to move cargo and personnel from the Aerial Port of Embarkation (APOE) to the Aerial Port of Debarkation (APOD) wherever

⁴¹ Major Bryan Huntsman, “HQ AMC TACC Fusion Cell Charter,” 30 July 02.

⁴² Ibid.

the two may be IN or OCONUS. The boundaries of this link extend from the receipt and in-check of cargo into the APOE to the release of cargo from the APOD for processing and delivery to the final destination. This section will attempt to familiarize the reader with the responsibilities of the AMC APOE-APOD link in the supply chain. Doing so will enable later chapters to provide a clearer understanding of the Air Force's current cargo tracking AIS system, the Global Air Transportation Execution System (GATES), as well as the role that RFID can and could potentially provide in creating value for AMC's in its day to day and contingency (unit move) operations.

1. Entry into the APOE

When a shipping entity or sponsoring authority decides to use airlift (assuming it is eligible based on the criteria in DoD 4515.13-R, *Air Transportation Eligibility*) in shipping an item to its recipient at the end of the supply chain, a decision that is based on various criteria, the shipping entity is responsible for completing a form called the Advanced Transportation Control and Movement Document (ATCMD). This is the form that inputs the data associated with a particular cargo into the Defense Transportation System (DTS). When the document is electronically filled out using the Financial and Air Clearance Transportation System (FACTS), an electronic clearance system used by all DoD military Services since 13 April 2001, a copy of the document is sent to the Services' respective Air Clearance Authority (ACA) via FACTS requesting permission to use airlift to move the particular piece of cargo to its destination. The ACAs, in turn, will either clear the shipment for airlift or challenge it based on DoD 4500.32 R/AFI 24-201.⁴³ If clearance is given by the ACA, the clearance ATCMD data is inputted by the ACA into the APOE's database (using GATES) so that the cargo will be allowed to be airlifted from the APOE to its ultimate APOD.⁴⁴ If this ATCMD data is not received by the APOE before cargo arrives, the cargo will be "frustrated" by the APOE when it does actually arrive and is checked into GATES. It will remain frustrated until it is determined if airlift should be used to transport the item. This task is accomplished via consultation between the APOE, the ACA and the original shipper and results in significant time and

⁴³ "Cargo and Mail," AMC Instruction 24-101, Volume II, [<http://www.e-publishing.af.mil/pubfiles/amc/24/amci24-101v11/amci24-101v11.pdf>], 30 June 2001.

⁴⁴ "Electronic Business," [http://www.ec.navy.mil/nav_eb/projects.asp], 5 November 2003.

labor expenditures, and can ultimately cause a piece of cargo to be delayed indefinitely until its status is cleared up in GATES.

Assuming that the cargo arrives at the APOE and the Transportation Control Number (TCN) has been cleared by the ACA through GATES, the cargo is in checked into GATES and its status is listed as “in checked,” “processed,” or “frustrated” in which case the reason for frustration will also be indicated.⁴⁵ The fact that this information is inputted into GATES allows ITV for clients with access to GATES or GTN (as GATES is a GTN AIS feeder; this will be discussed in Chapter 5).

The next macro step in the APOE processing is the breakdown or building of pallets. The important concept in palletizing is that as cargo arrives, whether loose or palletized, after it is in checked into GATES, any changes in a pallet must be accompanied by making corresponding changes in the GATES database in order to maintain accurate ITV.

After palletizing, a load plan is created by the APOE as well as a manifest that indicates the contents of the actual airlift. APOE personnel enter this information into GATES. It is this information that provides GATES and GTN clients with ITV of cargo between APOE and APOD. Upon departure of the aircraft, GATES is updated again to indicate that the cargo has left the APOE and is enroute to the APOD.

2. APOD Role

The APOD is responsible, upon the arrival of the aircraft, for entering into GATES that the cargo was actually received by the APOD, providing yet another ITV information bit. The cargo is then inspected to ensure that the quantity expected based on GATES database information is the actual quantity received. Any overages or shortages are noted in the system. Once the receipt by the APOD process is completed, an onward movement manifest (surface or air) is created for the benefit of the next entity in the supply chain. The cargo is then characterized “outgate” in GATES, which signals the end of AMC’s responsibility for the cargo. Officially, “AMC possession time terminates when it is released to the carrier or the consignee”.⁴⁶ It is at this moment that the cargo

⁴⁵“Cargo and Mail,” AMC Instruction 24-101, Volume II, [<http://www.e-publishing.af.mil/pubfiles/amc/24/amci24-101v11/amci24-101v11.pdf>], 30 June 2001.

⁴⁶ Ibid.

leaves the AMC portion of the supply chain and continues on via whatever transportation mode is being used by the supply or requestor activity for ultimate delivery to the final destination.

V. OVERVIEW OF THE GLOBAL AIR TRANSPORTATION EXECUTION SYSTEM (GATES)

A. INTRODUCTION

The primary AIS system used by AMC APOEs and APODs to track cargo and passengers along with performing the myriad tasks associated with this link of the supply chain is GATES. In order to understand where value can be obtained using RFID, the value that GATES currently provides to AMC must be understood. This chapter will give a brief history of the development of GATES, the current status of GATES, some of the APOD-APOE specific applications of GATES, as well as a very brief description of two of the important AIS's feeding GATES.

B. ORIGIN OF GATES

In 1992, the Air Force was using five legacy systems to track cargo, passengers and manage its link of the supply chain. As was the case with many DoD activities after the Gulf War, the Air Force decided that it required a system that could incorporate the functions of the antiquated legacy systems into one robust system that could be used in AMC activities worldwide. The new system would eventually incorporate cargo and passenger tracking, resource management capabilities, provide logistical information through a shared relational database, as well as message routing and delivery services for airlift data.⁴⁷ The system was designed in a joint effort between AMC and Lanham, MD based TRI-COR Industries, Inc. From the outset in 1994, GATES was designed to be implemented in three phases. The initial phase, which occurred only three years later in November 1997, replaced the legacy systems at HQ AMC. The second phase, in 1999, saw the installation of GATES at AMC aerial ports IN and OCONUS as well improvements on the system installed during the initial phase. The final phase involved working out the flaws that had been detected through learning associated with the use of the system.⁴⁸ The incorporation of GATES into AMC's IT infrastructure replaced AMC's primary legacy cargo tracking system, the Consolidated Aerial Port System II (CAPS II).

⁴⁷ "TRI-COR Software Solutions," [<http://www.tricorind.com/sales/software.htm>], 2002.

⁴⁸ Ibid.

C. CURRENT STATUS OF GATES

The current version of GATES being used by AMC is GATES version 2.06, which requires the sending of a text (.txt) file to the Defense Automatic Addressing System Center (DAAS or DAASC) that, in turn, responds with a TIGR Array Viewer (.tav) file back to the GATES client. The GATES client then sends relevant TCMD data to DAAS using an intersystem buffer called TIPS. It is through the TIPS buffer that GATES burns supply information onto RFID tags. DAAS takes the TCMD from GATES and pairs it with supply information on the particular item. DAAS then forwards the information to the Regional In-Transit Visibility (RITV) server. It is through the RITV server that GTN is made aware of the tag that was written and the information with which it was populated. This complicated process is shown in Figure 4.

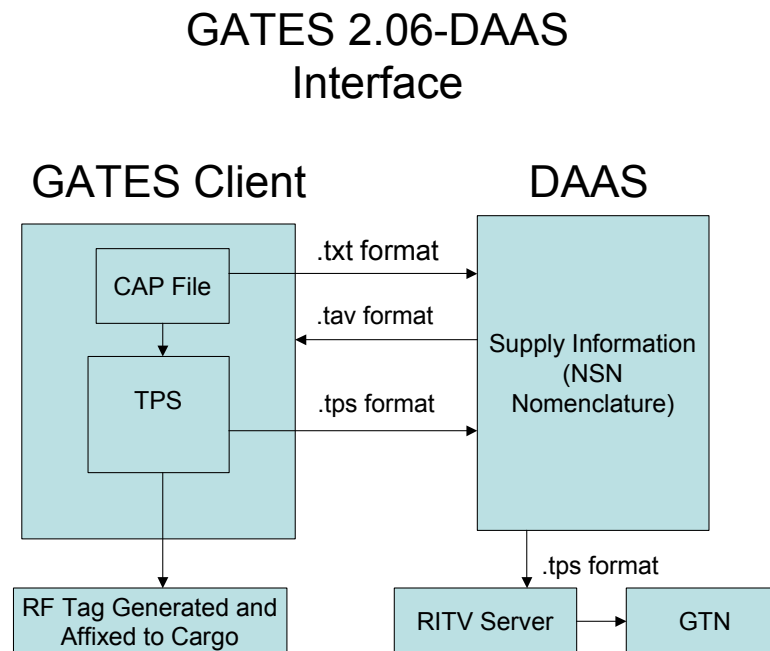


Figure 4. GATES-DAAS Interface

The follow-on version of 2.06, version 2.07, is currently available on the GATES central server but it not yet operational on the client level. It is this version of GATES that will allow the burning of an RF Tag at in check with DAAS supplied supply data that can be sent directly from GATES to the RITV server and ultimately to GTN without going through

the DAAS AIS. An even more current version of GATES designed and to be maintained by Computer Sciences Corporation, version 2.08, is already well into the design phase and is due to be operational in 2004. It will incorporate new requirements specified in the GATES to RITV server Interface Requirements Design Document (IRDD) that should allow for improved communication between GATES and the RITV server.⁴⁹

D. GATES' STAKEHOLDERS

GATES' stakeholders are many. They include HQ AMC, AMC Logistics Operations Branch, the TACC at Scott AFB, Air Clearance Authorities (ACA's), and work centers such as the Air Terminal Operations Center (ATOC). Primary users of GATES are HQ AMC (including the TACC) at Scott AFB and AMC's worldwide aerial ports.⁵⁰ There are also deployed GATES systems used in more austere environments. These deployed systems are outside the scope of this project and will not be discussed.

E. GATES ARCHITECTURE

Trying to understand the digital labyrinth that makes up the DoD logistical AIS is, conservatively stated, daunting. Improvements to the AIS's are constantly being made. It is not uncommon to find that a patch, band-aid, or improvement to one system can be rendered obsolete by the introduction of another system only months later. The Armed Services are constantly modifying and replacing their Intraservice (same Service) and Interservice (Service to Service) AISs and the architectures upon which they are built.

1. Record Types

Users of GATES have various categories with which they can characterize or specify various types of cargo shipments. These cargo related "record types" include among others:

- Shipable_units
- Shipment_unit_frustrated_event
- su_vehicles
- su_explosives
- human_remains

⁴⁹ RFID working group phoncon, 29 October 2003.

⁵⁰ "GATES AIT Update," [http://www.dodait.com/conf/ipt/092000/15/1], 2000.

- pallet_detail
- pallet_frustrated_event
- air_manifest - manifests are created and maintained in the GATES database
- manifest_loose_cargo
- manifest_palletized_cargo
- aircraft
- surface_mission_stop

These asset categories allow GATES client and GTN users to “drill down” through large quantities of logistical data in order to view the desired information. The types of data provided by these record types tend to focus on general visibility of pallets and individual cases of cargo within the APOE-APOD link. This is not a surprise in that during the development of GATES, TRI-COR understandably “interviewing users at HQ AMC and the arrival ports and analyzed the existing legacy systems”.⁵¹ GATES is a system that is better suited to promoting efficiencies within its own supply chain link of operations and not as well suited to increasing efficiency throughout the supply chain.

2. Feeds to and from GATES

GATES uses a number of different feeds to accomplish its logistical missions. Figure 5 illustrates the AIS’s feeding and receiving from GATES as of December 1999.⁵²

⁵¹ “TRI-COR Software Solutions,” [http://www.tricorind.com/sales/software.htm], 2002.

⁵² “GTN Feeder System Data Flow,” USTRANSCOM slide show, 2 July 2002.

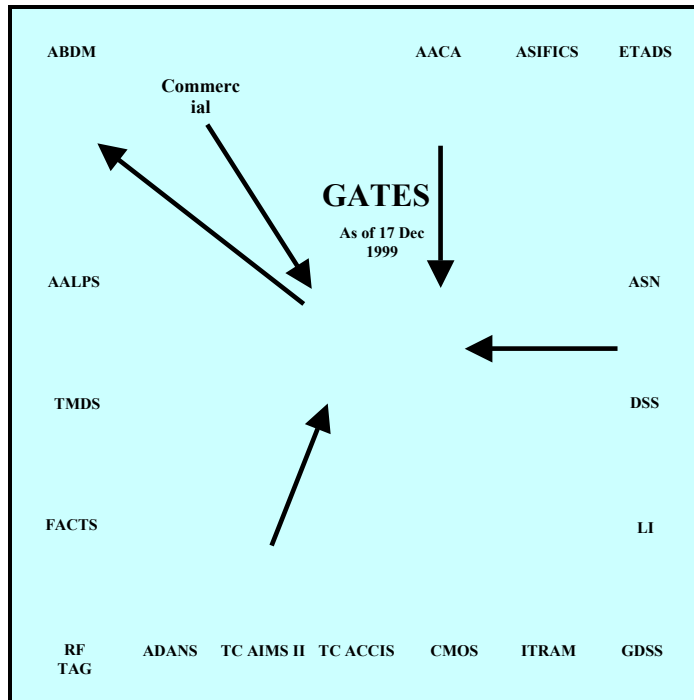


Figure 5. GATES Interfaces

AMC's Cargo Movement Operations System (CMOS) is one of the systems that feeds and is fed by GATES. CMOS is widely used by the Air Force to coordinate movement of cargo within CONUS. One particular element within CMOS's array of functions is to provide a manifest of cargo moving within CONUS. CMOS provides GATES with information on these surface movements of cargo.

Another AIS providing valuable logistical information to GATES is a joint system, the Transportation Coordinator's Automated Information Movement System (TC-AIMS II). TC-AIMS II is another AIS that provides detailed unit equipment lists as well as actual movement manifests and departure information for air and ground movement. It provides for the same for sea movement as well. Many of the transactions inputted into TC-AIMS II, including preparing cargo manifests for trucks, reporting the departure of cargo trucks and their subsequent arrival at APOE's, the preparation of another manifest at the APOE and the departure of the aircraft, are the same ones that are accomplished by GATES at AMC's aerial ports.

3. Technical Conclusions

Looking at the feeds into and from GATES and the resulting data that is available to GATES users, it is easy to understand how GATES stakeholders are content with its capabilities. Not only does it perform admirably in processing transactions within its own link of the supply chain, it also receives feeds from other links of the chain to provide its users with even more visibility of incoming cargo. It is simple to conclude, looking at Figure 5, that GATES was written to assist with one piece of the supply chain, not to serve as a panacea for the entire chain. It appears as though other AIS's that could potentially provide valuable information to GATES were "fitted" with interfaces to create a GATES database that is more robust, giving further visibility up the supply chain. The systems feeding into GATES are no different. They were designed with a specific functionality in mind. The aforementioned AIS's, CMOS and TC-AIMS II are good examples of this.

F. GATES' CURRENT INTERFACE WITH RFID

Figure 4 depicts a two-way data highway between GATES and the RFID tag. The only information passing between GATES and RFID tags is the burning of supply data onto the RFID tags via the TIPS buffer used in conjunction with the GATES client at the APOE's before the cargo is sent to the CENTCOM AOR. GATES is the feeder of information. The RF Tag contributes nothing to GATES except a tag ID number that is passed along with the supply information via DAAS to the RITV server and on to GTN.

Nothing was uncovered during the project team's research at HQ AMC Scott, USTRANSCOM, and the aerial port at Travis AFB that provided any evidence of value being derived from RFID tag usage. This statement includes the TACC and its Fusion Cell at Scott Air Force Base. GATES was the most mentioned AIS when the subject of cargo tracking and managing was discussed.

VI. THE AMC LINK OF THE SUPPLY CHAIN AND AMC'S RFID DILEMMA

A. INTRODUCTION

This chapter provides an explanation of the DoD supply chain and identifies the specific position AMC occupies within it. This brief explanation will enable the layman to better understand the possible future applications for RFID in the DoD supply chain. It will also provide the required framework to understand the dilemma AMC currently faces regarding RFID implementation and utilization. The chain will be explained through a description of two different flows: cargo and information.

B. DoD SUPPLY CHAIN

Figure 6 shows a simplified scheme of the DoD supply chain for explanatory purposes.

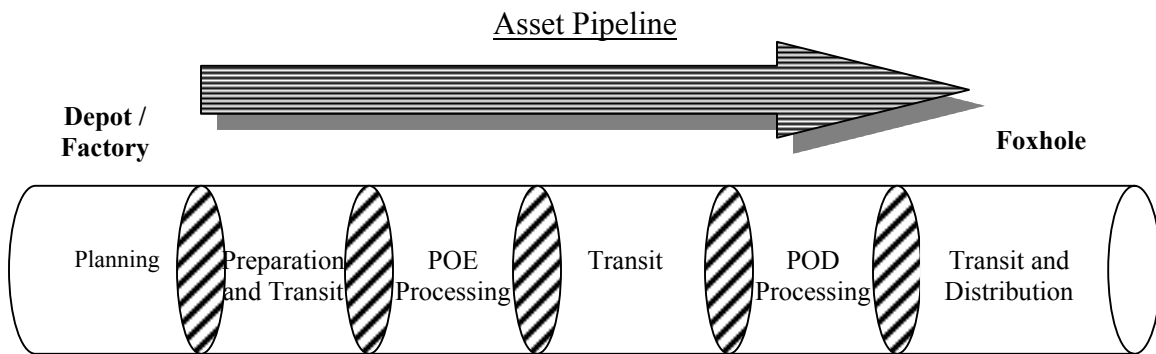


Figure 6. DoD Supply Chain Asset Pipeline

The planning stage comprises all of the activities related to the receipt and processing of a requisition. Included in this stage are commercial direct vendors, manufacturers and supply depots. Their specific functions include the receipt of the supply requisitions, invoice processing, producing or releasing the ordered material and the shipment of items to the next stage.

The preparation and transportation stage comprises all activities to be done at cargo consolidation points or depots. This includes all the activities related to the receiving of cargo from the planning stage shippers, consolidating the cargo, populating

the respective AISs that will control the cargo flow and provide asset visibility, and ultimately the shipment of the cargo to the port of embarkation

The Ports of Embarkation (POEs) receive the cargo, verify the destination manually or through AISs, mark with RFID tags cargo ultimately bound for CENTCOM (and Diego Garcia, British Indian Ocean Territory) destinations only, and based on the nature of the mode of transportation requested and authorized, send the cargo to a Port of Debarkation (POD) by sea or air. Primary evolutions within this stage include proper cargo receipt, verification and matching of the cargo with clearances, processing of frustrated cargo (as was explained on Chapter 5), cargo depalletization/repalletization management, cargo loading, and the associated asset and cargo inventory planning required for cargo shipping.

Transit involves the moving of the cargo from the POE to the POD. Important issues related with this activity are maintaining planned departure and arrival schedules. RFID currently plays little role providing visibility while the cargo is being transported from the POE to the POD. GPS assisted tags could potentially provide value in this arena, especially in ground and sea transportation. The Army's Defense Transportation Recording and Control System (DTRACS) provides GPS capability for land-based transits. Concerning the realm of AMC, the RFID infrastructure onboard aircraft transiting from APOEs to APODs is currently non-existent, thus the ITV provided by RFID stops at the APOE and does not resume until the aircraft lands and the pallet is scanned at the APOD. GATES is AMC's AIS of choice for tracking cargo in transit and does not benefit from inputs from RFID on the ground or while in transit. The team has no evidence that there is any current movement within AMC to incorporate RFID and GPS capability for in flight ITV.

PODs are the entities that receive, check, and direct the cargo to the next port or to the consignee depending on whether the cargo has reached its final destination or requires further transport to another port/aerial port. Specific activities performed at the POD include the unloading of the cargo, containers or pallets as well as the "breaking down" of pallets in order to expedite the scheduling and processing of further supply transits, which leads to the final stage, Transit and Distribution. This stage, known as

“the last mile,” comprises all the activities related with the cargo transportation from the POD to the final consignee and all of the processing tasks required to perform these activities. It is during this “last mile” that cargo is often invisible to the ITV network in that the infrastructure required to feed GTN with visibility information is not sufficiently robust or is altogether non-existent.

C. DoD SUPPLY CHAIN CHALLENGES

The supply chain as described above and depicted in Figure 6 is a complex web of interwoven activities. It is a dynamic and enormous system and represents one of the largest logistical challenges in the world, if not the largest. The fact that it is a government system coupled with the advances in supply chain technology and knowledge makes it a system that is ripe for improvement. An efficiency gained or lost at any stage of the chain can have impacts not only on the stage where the change was implemented, also on stages both up and down the supply chain from where the problem or improvement occurs. Additionally, due to the bullwhip effect, the positive or negative change or event that occurs within a link of the chain will tend to have larger and larger impacts as its effects move both up and down from the origin of the change or event. Finding a way to optimize the entire supply chain (global optimization) to perform efficiently as one entity is an enormous undertaking, and the development of GTN and JTAV took the first step in making this progress toward a more efficient supply chain possible. Still, the variance that occurs in the chain that results from inefficiencies and uncertainties on the part of all chain members continues to have negative impacts on the ultimate customer, the war fighter.

The DoD supply chain has the inherent weakness of being run by different Services and serving different Services, with each Service managing their own assets (DLA being the major exception) and having their own logistics priorities. Every individual stage of the supply chain tends to base decisions on how best to optimize their own operation within the constraints of its own budget. The cultural differences between Services do little to assuage communication and coordination problems. These issues have negative effects on the ability of DoD to globally optimize its supply chain.

In addition, the DoD supply chain operates in different countries, serving different customers who may operate in unstable environments. These customers have different supply needs at different times, and their missions and access to supply lines are as varied as their requisitions. This creates a high level of external supply chain demand variability that is reinforced by the Services' imperfect control of internal and external supply chain processes, the two of which result in a high degree of variance in the supply chain as a whole.

RFID can play a significant role in improving DoD's ability to overcome supply chain challenges. It is a technology that can capture deviation from expectations well forward in the supply chain pipeline and make the deviation visible to all stages of the supply chain so that solutions can be implemented before the end user is adversely affected. RFID can allow DoD supply chain managers (as well as commercial suppliers and transporters operating within the chain) more time to solve supply chain optimization problems by alerting them to problems in near real time. This capability would enable them to take a more proactive role in predicting logistics issues as opposed to the traditional reactive role in which logistical problems are addressed after they become well entrenched. Not only can globalization problems be quickly identified and corrected, RFID can also permit stages within the supply chain to execute their own processes faster and more accurately. The end result of both improvements is significant cost savings and faster supply chain throughput for all entities within the chain, efficiencies that result in better part availability and faster transport of parts to the end user.

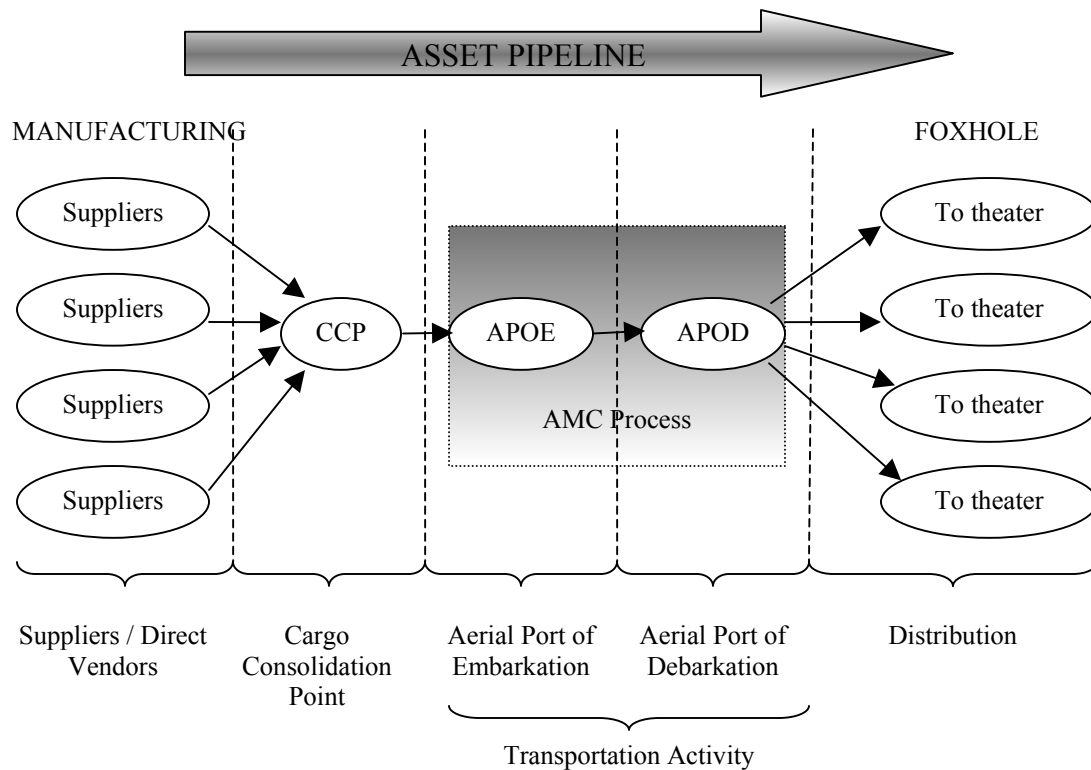


Figure 7. DoD Cargo Flow

D. AMC CARGO AND INFORMATION FLOWS

Figure 7 shows the cargo flow through the various stages of a supply chain and where within the chain AMC focuses its operations. As previously mentioned, the core business of AMC is transportation, which includes the associated APOE activities of receiving and breaking down of pallets, repalletizing, RFID tagging (for CENTCOM bound pallets), storing and ultimately loading the cargo onto aircraft. The APOD activities include the receiving, depalletizing and forwarding to the final consignee as well as the planning, programming and executing of the airlift missions.

Figure 8 is a schematic representation of the information flow through the stages of the DoD supply chain emphasizing the role of AISs used by AMC.

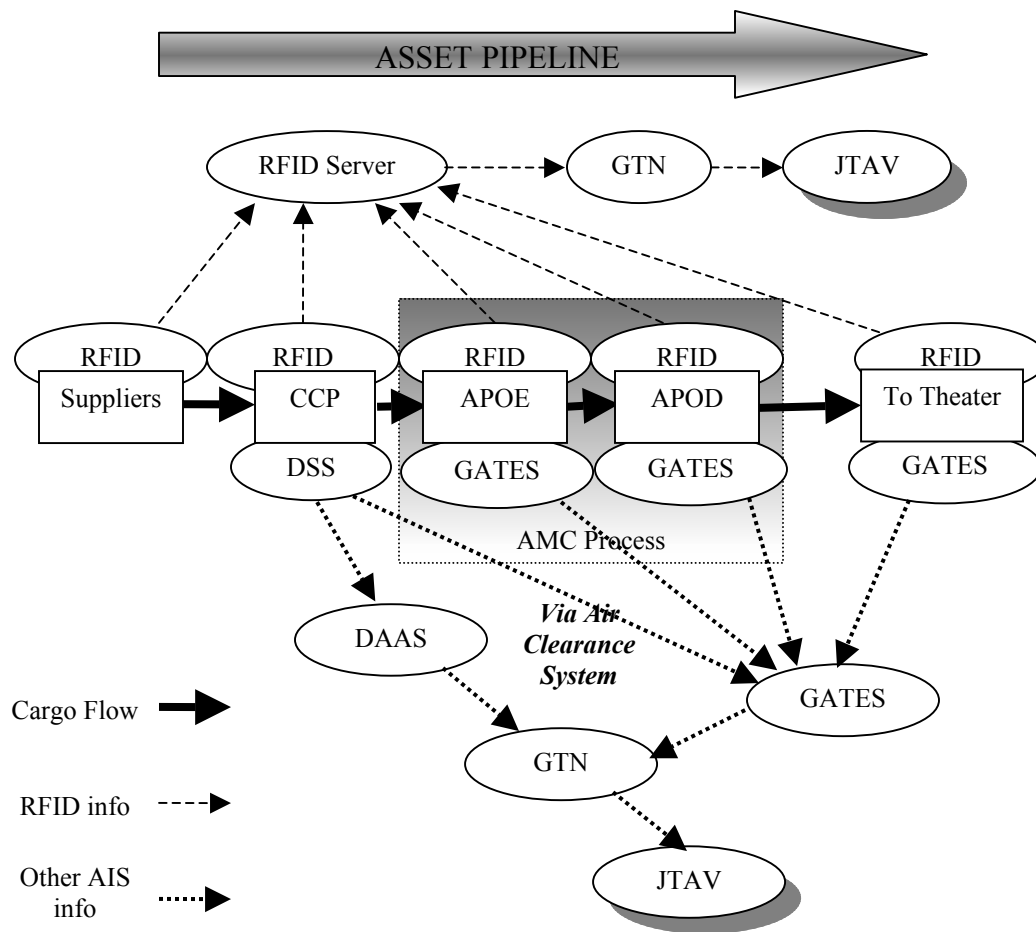


Figure 8. DoD Cargo and Information Flow

Suppliers receive requisition orders through CEDI (Commercial Electronic Data Interchange) system, which, in turn sends a shipping status message to the desired transportation carriers (truck, air, rail or ship). At the second stage, CCP uses the Distribution Standard System (DSS) to provide status reports that are visible to DoD supply and transportation entities. When the cargo arrives to the third stage (APOE), the AIT affixed to the piece of cargo or pallet is read and the information is sent to GATES. If there is not an AIT affixed on the cargo when it arrives at the APOE, the cargo information must be populated manually into GATES. Then, the system reconciles the data with the clearance received by GATES from the ACA concerning the individual

piece of cargo being shipped. If there is no match, the cargo is frustrated and remains so until it can be validated through a time consuming manual process.

E. AMC'S DILEMMA REGARDING RFID IMPLEMENTATION

1. Incentives

In the case of AMC, reliance on legacy systems (primarily GATES) for cargo tracking has been and continues to be a hindrance in building an acceptance of RFID into the culture of AMC operations. The mentality behind this reluctance to fully implement RFID into the AMC business process was articulated by one senior enlisted source at a CONUS AMC aerial port who stated that “there is no value in RFID; it’s more for the end user.”⁵³ He went on to add that “GATES is a tried and true system.”⁵⁴ This sentiment reflected the prevalent feeling relayed to the project team members by many Air Force personnel interviewed through the course of the research.

DoD-wide, beginning with the CENTCOM mandate, RFID has been haphazardly implemented into supply chain activities, especially those supporting CENTCOM operations. Tags are placed on pallets at AMC APOEs only to have the pallet appear to be stuck at the APOE due to insufficient post-APOD RFID infrastructure at the receiving end of the chain. This deficiency in the system has done nothing to encourage confidence and further study into the potential benefits of RFID by supply chain activities. Hence, mandates have become the only incentive for further implementation, and even then it is begrudgingly achieved with mixed results.

Another significant roadblock in the process to create a robust RFID infrastructure that enjoys full utilization within the DoD supply chain is the lack of research in qualifying and quantifying the value that RFID can provide to individual supply chain entities and the supply chain as a whole. There is ample information on the structure of the DoD’s AISs and the how RFID feeds GTN, but there is little understanding by budget controllers and decision makers of RFID’s potential outside of providing the ITV or TAV that are the buzzwords of today’s logistics. These capabilities are but the “tip of the iceberg.” Until DoD logisticians are educated about what RFID

⁵³ Phone conversation with an AMC Aerial Port Operations member, 20 November 2003.

⁵⁴ Ibid.

could do for their respective activities and for the supply chain as a whole, RFID implementation will likely not be a coordinated or rapid undertaking.

The fact is that there is little incentive built into the supply chain to encourage chain members to invest their money into creating an RFID infrastructure that the chain members assume would benefit only the end user. The memo from the Acting USD(AT&L) states that the infrastructure that is to be constructed to support RFID based ITV will be built using money from “routine Operations and Maintenance or Working Capital Fund processes.”⁵⁵ It specifies that it is the responsibility of the activity at which containers, consolidated shipments, or air pallets are built or reconfigured to “procure and operate sufficient quantities of RFID equipment [this includes actual infrastructure and tags].”⁵⁶ Considering that the activities within the supply chain on whom the majority of this new budgetary burden falls (i.e., DLA and AMC for air shipments) have fewer assets and arguably interests in the CENTCOM theater than do the Services that use the data more often (Army and Marine Corps), the aforementioned lack of enthusiasm in RFID expansion is understandable. Not being able to quantify or qualify the benefits that AMC could derive from RFID use only compounds the problem.

The question, then, is how to incentivize AMC to willingly incorporate a robust RFID system into their operational scheme. This question can be answered by answering another question: “How can RFID help us (AMC)?” It is unlikely that passing along the costs of RFID implementation to AMCs airlift customers will have any significant impact on expanding RFID’s role in their operations, as the ultimate goal of such a process is to break even. Breaking even is not a monetary incentive to implement a new process or infrastructure. Thus, the nature of government supply chain business dictates that the incentive must come from instilling a desire within AMC to improve its processes. AMC must believe that RFID can help them create efficiencies within their own operations and in those of other supply chain members. They must believe that they can use the money saved from RFID created efficiencies for other activities that add more value to their operations other than simple receipt, palletization and loading activities.

⁵⁵ Ibid.

⁵⁶ Ibid.

New incentives can come in the form of rewards based on new metrics. If the processing time of cargo into an APOE can be reduced using RFID, then the efficiency gained should be one that is rewarded. Instead, efficiencies are often hidden or not pursued at all because of concerns that reported efficiencies can lead to a loss of funds in budget out-years. The preservation of budgets drives the decisions of most DoD entities, including those in the supply chain. This is a mentality that is not conducive to a creative environment where innovation is rewarded. It is naïve to think that this problem can be fixed overnight, but suffice it to say that it is another impediment to inquiry into how this new technology can help the DoD supply chain. Until the problem of cultural resistance is rectified, any strides to achieve supply chain efficiencies using any sort of AIT, including RFID, will be slow, forced, stovepiped, and marginally effective.

2. Cultural Issues

It is very apparent that, outside of providing spotty cargo visibility for end users of the RFID component of GTN, Department of Defense supply chain entities have experienced few successes in using RFID technologies to improve their own operations and are largely ignorant of how to even begin learning how it can be used to globally optimize the supply chain. AMC's efforts to incorporate RFID into their operations are a good illustration of how difficult it can be to understand RFID technology and even more difficult to fully benefit from its capabilities.

AMC aerial ports remain GATES centric operations. They are struggling to determine the value, if any, that they can derive from using RFID in their cargo receiving, handling, and transporting operations. According to one senior member of an AMC Aerial Port Squadron, "RFID would mimic what GATES already does."⁵⁷ This mentality along with the fact that RFID is not widely considered beneficial to AMC, but rather to the Army and Marine Corps, are some of the likely reasons that the memorandum was issued on 2 October 2003 by Michael W. Wynne, the Acting Under Secretary of Defense (AT&L) mandating the placing of RFID tags on "key high value items" already existing in the DoD inventory as well as on the "lowest possible piece/part/case/pallet packaging

⁵⁷ Ibid.

by January 2005.”⁵⁸ The memo is a result of the slow movement across the Services to implement this promising technology despite its proven value in the CENTCOM Theater’s logistical operations.

The unwillingness to embrace RFID also stems from the fact that the technology’s beginnings in the DoD were beneficial to the ground based Services. Tracking parts through a supply chain, especially the ground elements of a supply chain, are not congruent with AMC’s airlift-focused culture. AMC, just like the other elements of the supply chain, focuses primarily upon its own operations simply because there has never been a technology that would allow them to do otherwise. The capabilities that RFID can provide are much newer than the long engrained culture of concerning oneself with one’s own Service. This is to say that before ITV was possible, the fact that there was no possible way to look at the flow of goods through a chain in real time played a major role in AMC’s culture of focusing on its own operations instead of concerning itself with the benefits it could derive from another supply chain member’s efficiency gains. The mentality being if the cargo got to the APOE on time, it left on the next scheduled plane if there was room and if its priority was sufficiently high. If it was late, then it left on the next plane. It was not the most efficient way to do business, but without any ITV, there were few other possibilities. Now, the culture that was born from the era of no-ITV has the opportunity to transform its processes around a new capability. As was mentioned in the section above, this transition can come directed from above or from within, the latter being more likely to succeed both in implementation as well as in creating value for the chain.

⁵⁸ Office of the Under Secretary of Defense (AT&L), Radio Frequency Identification (RFID) Policy, 2 October 2003.

VII. RFID: SO MANY USES, SO LITTLE UNDERSTANDING

A. INTRODUCTION

To date, RFID has been little more than a band-aid to help end user and CENTCOM staff logisticians locate where inbound cargo is within the supply chain. This is an obvious, yet completely valid, use of RFID technology. Using RFID in this manner, however, is only one of myriad ways that this AIT can completely revolutionize the way that AMC and its supply chain partners do business. The fact that DoD is one of the pioneers in using RFID tags on a grand scale has the unfortunate consequence that very few examples are available of previous commercial or governmental use of the technology upon which it could build and modify its own RFID logistics practices.

This chapter will make the argument that RFID is a significantly underutilized tool in the DoD logistics AIT arsenal. It will do so by restating how RFID is currently being used, how its most recent mandate envisions it being used in the near term, and how it could be used in the future once proper RFID infrastructure is in place and personnel and metrics are properly aligned to take full advantage of a mature RFID system. To accomplish this, parallels to the DoD supply chain can be drawn from commercial supply chain RFID research performed by the Massachusetts Institute of Technology based Auto-ID Center.

Dr. David Brock and Professor Sanjay Sarma of MIT formed the Auto-ID Center on October 1, 1999. After meeting with Kevin Ashton of Procter and Gamble, they concluded that if the technology could become affordable, that it could revolutionize supply chain and retail management. They presented the idea of forming a center dedicated to the open standardization of RFID and the creation of applications for RFID to Al Haberman, a member of the Uniform Code Council (UCC) and the man regarded as the father of the bar code.⁵⁹ The eventual funding for the center came from the UCC, The Gillette Company, Procter and Gamble, and from the head of the Department of Mechanical Engineering at MIT. The center completed its research and closed, as planned, on October 26, 2003. The work of the lab transferred to EPC (Electronic

⁵⁹ "History of the Auto-ID Center," [<http://www.scenicviews.org/AutoIDLabs/history.htm>], 21 November 2003.

Product Code) Global (www.epcglobal.org), an organization that is now charged with further work on developing the standards for the technology.⁶⁰

Many of the RFID applications described by the Auto ID Center can be applied to individual entities within the supply chain for sequential type benefits. Others can be applied to the various links in the chain to produce value for the entire chain. The following sections will describe these RFID applications and will indicate where in the DoD chain value can be created as well as which entities stand to gain from the value created.

B. CURRENT DOD UTILIZATION

1. APOEs

RFID's primary role in DoD logistics received a big boost in July 2002 when Commander, CENTCOM, General Tommy Franks, issued an order stating that "all containers arriving in the CENTCOM Theater have RFID tags."⁶¹ To this end, AMC APOEs are placing RFID tags on all CENTCOM and Diego Garcia (PACOM activity, staging ground for CENTCOM operational support) bound pallets. This tagging allows the CENTCOM J4 staff and other CENTCOM C2 elements as well as some CENTCOM and Diego Garcia requisitioning activities with access to GTN to track their incoming pallets. The RFID tags being placed on the pallets at the APOEs provide data only on the boxes (case level visibility) that make up the pallet. The contents of each box are not always listed on these RFID tags.

2. DLA

DLA activities such as DDJC Tracy are placing RFID tags on all of their CENTCOM and Diego Garcia (PACOM entity whose assets service targets in PACOM and CENTCOM) bound shipments to APOEs such as Travis AFB. According to the RFID Journal, in October 2003, "DLA set out a new policy that expands active RFID tracking to all military shipments of sustainment cargo, unit movement equipment and

⁶⁰ Ibid.

⁶¹ "Tracking a Needle in a Haystack,"

[<http://www.defenseworld.net/html/Graphical%20Reports/Radio%20frequency%20identification.htm>], 21 November 2003.

cargo, ammunition shipments, and prepositioned materiel and supplies.”⁶² Specifically, DLA is tagging boxes with information on the contents of the box. The tagged boxes are placed on a pallet that is subsequently tagged with the contents of the pallet.⁶³ This is an aggressive move by a supply chain entity that provides “90 percent of the military’s construction materials, such as sandbags and concertina wire, as well as 90 percent of repair parts for aircraft, tanks and other critical assets.”⁶⁴ Though this expansion of RFID usage is commendable and demonstrates a better understanding by DLA of the potential benefits of the technology, others have not followed suit so readily. AMC is included among those who have not had the resources or training required to develop RFID into a system that could benefit their APOE-APOD supply chain link as was entailed in Chapter 6.

3. Commercial Direct Vendors

Direct Vendor supplies that do not have a tag affixed to the box or piece of cargo arriving at APOEs for transport to CENTCOM destinations are in-checked into GATES and consolidated onto a pallet based on the destination of the item. The pallet is then affixed with an RFID tag that serves to identify its contents. The absence of a tag on many pieces of incoming cargo is one of the reasons AMC does not trust RFID as a tool to plan for asset utilization. In order for RFID to create mature ITV value in the direct vendor cargo arena, all vendors must use the tags on their shipments, a goal mandated by the aforementioned Acting USD(AT&L) memo. Until this occurs, AMC will have no confidence in using RFID as a supply chain planning tool.

C. CURRENT SUPPLY CHAIN IMPACTS

Figure 9 depicts the limited, but available, value offered by RFID in its current immature state. The diagram shows that providing simple cargo visibility at strategic points through the supply chain can have beneficial impacts (create value) not only for the end user, but also for the original supplier, the cargo consolidation point, the APOE and the APOD. This utilization of RFID currently has little appeal for AMC, however, as

⁶² “Manugistics Adds RFID Capabilities,” [<http://www.rfidjournal.com/article/articleview/644/1/1/>], 21 November 2003.

⁶³ “U.S. Military Clarifies RFID Mandate,” [<http://www.rfidjournal.com/article/articleview/608/1/1/>], 21 November 2003.

⁶⁴ Ibid.

their primary concern is checking-in and tracking cargo flow between the APOE and APOD with GATES. What happens before the arrival of the cargo to the APOE and after it leaves the APOD is, from their perspective, of little concern. This is a classic sequential optimization mindset. One of the primary issues fueling this mentality other than the reliance on the “tried and true” GATES for cargo visibility is, as mentioned above, the immature RFID infrastructure throughout the supply chain and the sporadic tagging that has caused many well documented problems of incorrectly identifying the location and contents of cargo containers, pallets and boxes. Until the infrastructure of readers, interrogators, and other RFID supporting equipment becomes more robust and reliable, activities such as AMC will resist supplementing, let alone forgoing, their legacy systems in order to use RFID for cargo identifying and simple tracking purposes.

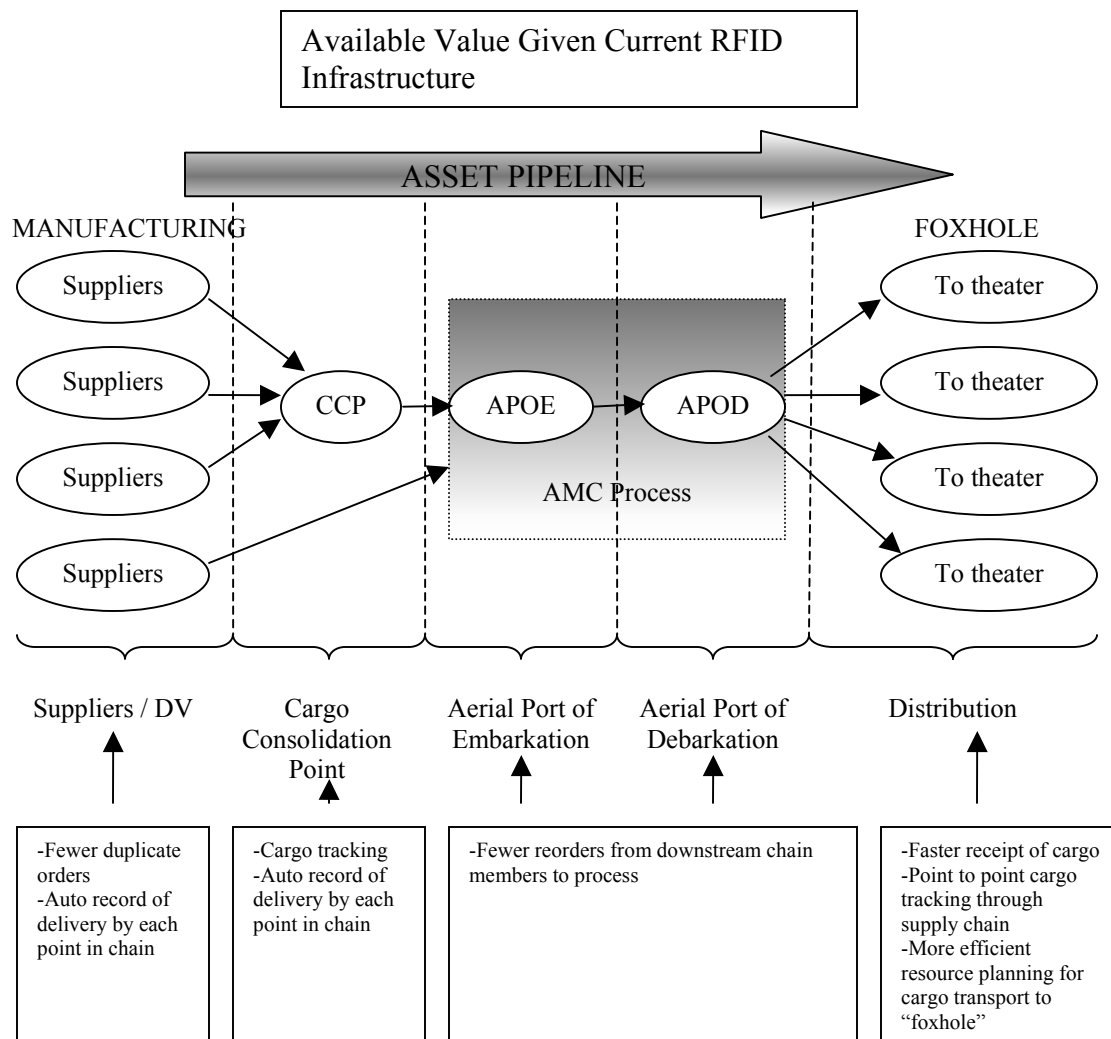


Figure 9. Available Value Given Current RFID Infrastructure

D. POTENTIAL NEAR-TERM RFID BENEFITS

The Acting USD(AT&L) memo of 2 October 2003 outlined for the respective Services where their RFID implementation efforts should focus. The specific elements mentioned include: receipt processing, part storage and issue, transportation, maintenance, and disposal.⁶⁵ The memo states that the applications “span the length of the DoD supply chain” and that the success of the technology will “be the institutionalization of Service/Joint processes and procedures.”⁶⁶ The two statements indicate an understanding that no one Service can implement the technology within its

⁶⁵ Office of the Under Secretary of Defense (AT&L), Radio Frequency Identification (RFID) Policy, Attachment 1, 2 October 2003.

⁶⁶ Ibid.

own operation and enjoy the full benefits of its use. Implementation must be undertaken with a global optimization view from the outset. The network and tagging must truly span the length of the supply chain. Some applications noted in the memo can be implemented and provide value immediately whereas others should wait until the network and scope of tagging becomes more robust and complete in order to provide any sort of value chain members.

1. Receipt Processing

a. Automated Data Capture

One of the initial uses of RFID in cargo handling operations advocated in the Acting USD(AT&L) memo involves the use of tags in receipt processing individual pieces of cargo or entire pallets. The memo states that the technology can be used to automatically update and value inventories. These are valuable applications. In AMC's case, automatically capturing the arrival of every piece of cargo into an APOE serves a number of purposes. First, it eliminates the manual task of inputting cargo into GATES. It also greatly reduces the possibility of human error of improperly entering the cargo into GATES or failing to enter it altogether. RFID tagging also eliminates the need to break down incoming pallets should they contain cargo destined for only one APOD. Currently, if a pallet arrives at an APOE from a vendor and it is not RFID tagged or labeled in such a way that personnel can determine the destination of its contents, the pallet must be broken down, rebuilt, and retagged. The labor and time involved in this process is significant. Data obtained from RFID automated data capture currently has limited use and will remain so until the mandate to tag all items entering the DoD supply system by January 2005 is fulfilled.

b. Automated Sorting

The use of barcodes to receive cargo into a supply chain entity is only as fast as the worker can align the box or pallet so that it can be read by the optical reader or in the case of no bar code, as fast as the employee is able to read the shipping label or manifest in order to create a new bar code for the item and enter it into the system. In some receiving scenarios in warehouses without automated receiving conveyors, cargo must be manually sent to various locations throughout the warehouse or sent to different

cargo receiving docks based on the ultimate destination of the cargo or size of the load. RFID tagged cargo can be received by one dock with fewer personnel and the cargo can be automatically routed to different locations in the warehouse depending on the requirements of the APOE personnel in AMC's case. Again, this receiving process can save significant amounts of time, particularly for high volume APOEs such as Dover AFB, where a reduction in the average time while increasing routing accuracy can have valuable benefits for AMC and entities further down the supply chain.⁶⁷ Figure 10 depicts the receipt processing value gained through RFID use not only by AMC APOEs, but also by other supply chain entities. All items must be tagged before they reach the CCPs and APOEs before the application of RFID in this arena can be considered mature. Until this occurs, cargo arriving at CCPs and APOEs without tags will require tagging by receiving personnel, thus slowing down the process, creating room for error, and limiting the value gained in the process.

⁶⁷ Michael Boushka, Lyle Ginsburg, et.al., "The Value of Auto-ID Technology in Freight Transportation," Auto-ID Center, Cambridge, MA, 1 November 2002.

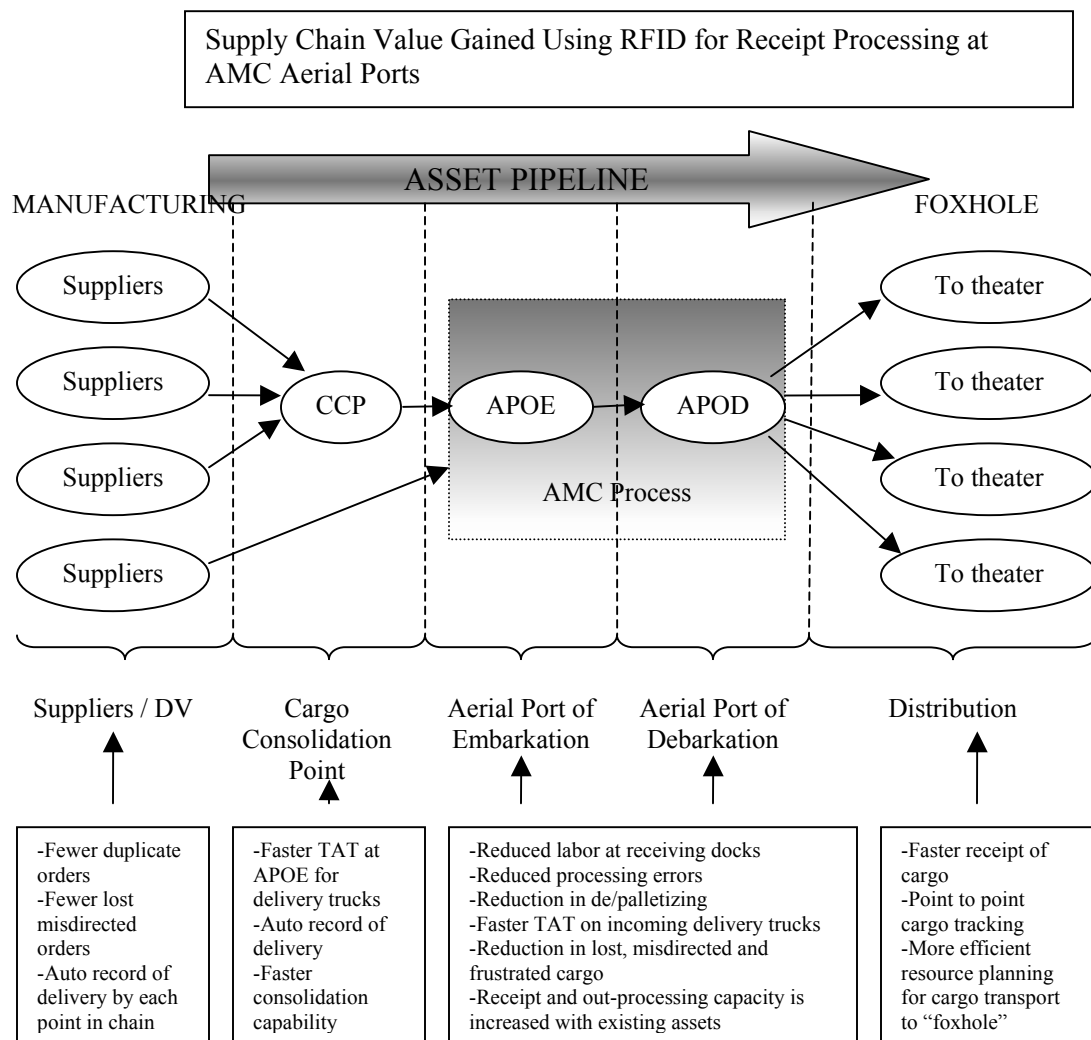


Figure 10. RFID Value in Receipt Processing

2. Storage and Issue of Parts

Storage and issue of parts is the second specific application mentioned in the Acting USD(AT&L) memo. It states that this category “includes inventory management.”⁶⁸ Inventory management includes myriad specific functions. Four specific functional areas of the managing of spares that have been identified by the Auto-ID Center as potential beneficiaries of RFID use include:

- Part on shelf visibility

⁶⁸ Office of the Under Secretary of Defense (AT&L), Radio Frequency Identification (RFID) Policy, Attachment 1, 2 October 2003.

- Reduction in safety stock
- Reduction in unusable stock
- Higher fill rates

These four applications of RFID tend to focus more on the management of inventories at supply depots such as DLA Distribution Depots and less on actual AMC aerial port operations. This not to say, however, that they do not impact the scheduling and operations of AMC's aircraft as well as AMC's repair part funds. A robust RFID item tagging and storage bin reading system at DLA activities (where 90 percent of spare parts for aircraft are maintained) could have significant effects on AMC's ability to cycle its aircraft between its aerial ports. Studies conducted by the Auto-ID Center indicate that excess quantities (safety stocks) of spare parts at all levels of the chain could be significantly reduced by providing downstream supply depot/warehouse shelf visibility to all supply chain customers. At the same time, reducing the demand variability can increase in-stock percentages. These benefits are achieved using RFID by increasing the "certainty" that supply chain members have in DLA stock levels and DLA's in-receipts (provided by DLA supplier RFID use). The subsequent reduction of spare aircraft part line items and safety stock quantities held at AMC aerial port activities translates into more available working capital for other requirements.⁶⁹

Another benefit of the certainty of being able to know, in real time, what DLA has on its shelves could be a reduced tendency of AMC aircraft maintainers to requisition, through fear of shortages, more parts than are actually required, the result of which is the high variability in demand. The bullwhip effect in the supply chain subsequently results as upstream suppliers scramble to guess the meaning of the increased demand and often order more than is necessary to compensate. The certainty that DLA carries the part or has the part coming in should reduce variability in order quantities and line items borne of uncertainty and lack of certainty and confidence in supply depots to have the parts on hand at any given time. These applications of RFID can be applied to high dollar DLA items immediately through tagging and infrastructure development at DLA. Later, as it becomes more cost effective, every part in the DLA inventory can be "viewed" in this

⁶⁹ Gavin Chappell, Lyle Ginsburg, et. al., "Auto-ID on Demand: The Value of Auto-ID Technology in Consumer Packaged Goods Demand Planning," Auto-ID Center, Cambridge, MA, 1 November 2002.

manner. The increase in working capital available for spare parts derived from better supply chain certainty and resulting smaller safety stocks and smaller orders throughout the supply chain could be very significant.

A third benefit of using RFID on all DLA items is the ability that it could provide to downstream supply chain members to quickly identify incorrect shipments of parts. In AMC's case, the receipt of an incorrect spare part can mean that an aircraft required for an operational lift can remain broken for additional days. If other assets are not available to transport awaiting cargo at the APOE, the cargo could sit for additional days while the correct part is shipped. Obviously, this can have devastating effects on downstream supply chain entities, especially the end user who is awaiting their part that is stuck on a broken plane. Being able to alert DLA about an incorrect shipment so another shipment can be immediately made could pay enormous dividends. A robust RFID system could immediately identify and verify an incorrect shipment against an outstanding requisition listing and automatically alert DLA's RFID system (assuming that for some reason DLA's system had not already identified and corrected the incorrect shipment) to the problem in order to stop the shipment before it left DLA's outgoing cargo dock.

These particular scenarios make apparent the immediate value that can be gained through implementing a robust system upstream in the chain. Robustness at the DLA level can solve or improve the four aforementioned supply chain challenges and though they are not directly applicable to the daily operations of AMC aerial ports, tapping in to a robust DLA system could have substantial positive impacts on AMC's ability to accomplish its mission in the most cost efficient manner possible.

3. Transportation

Transportation is the third element of the Acting USD(AT&L)'s RFID policy memo. The memo states that the "movement and consolidation for transshipment" of cargo are the focus elements for this application of RFID. These areas of RFID are being pursued today with varying degrees of success. As previously stated, CENTCOM bound cargo movement from DLA and forwarding operations such as the APOEs is already being tracked (again with varying degrees of success) with RFID to provide ITV for the end user. The consolidation benefits that RFID can provide are discussed earlier in this

chapter (see: Automated Sorting). There are many other uses of RFID in the Transportation realm that can add value to AMC's operation as well as those of the other chain members.

a. Asset Management

Placing RFID tags on the assets used by aerial ports in their daily operations to move cargo, items such as planes, tank trucks, forklifts, pallet jacks, carts, pallets, small containers, trailers, and intermodal shipping containers can be of great value to AMC. Quantifying the frequency that a specific asset is being used based on the number of times it passes by an interrogator can provide valuable data when making decisions about how to allocate funds for needed equipment. For example, in a scenario where a port owns three forklifts, but only uses two except during contingencies, RFID can gather data on the number of times each individual forklift passes by an interrogator to help logisticians decide whether to sell the third forklift and lease it during contingencies or to own third forklift outright.⁷⁰

Another benefit of being able individual assets is the ability to track the time required for a forklift to make runs back and forth when loading an aircraft or operating within a cargo holding building. Such data can be used to estimate movement and loading times per pallet, information that can help with asset optimization quantity decisions.

The possibilities of RFID utilization in the Asset Management arena are considerable. It is an application that can be realized in the near term by increasing the robustness of the RFID infrastructure at aerial ports and by tagging assets used in the actual movement of cargo within the warehouse as well as between aerial ports. The same benefits can be applied to all members of the chain.

b. Asset Tracking

A similar concept, but different area of value, involves the tracking of assets both within each member of the supply chain. The nature of AMC's business dictates that its assets are spread throughout the globe. During its interaction with its customers, it is inevitable that some of AMC's assets are lost. This could apply to items

⁷⁰ Michael Boushka, Lyle Ginsburg, et.al., "The Value of Auto-ID Technology in Freight Transportation," Auto-ID Center, Cambridge, MA, 1 November 2002.

such as cargo netting, pallet jacks, and aircraft parts. The implications of losing gear that must be replaced at some point through the normal course of operations can have significant impacts on AMC's operating budget. Assuming a robust RFID infrastructure in other links of the chain where AMC operates its assets, lost gear becomes found as long as it is within range of an interrogator and reader. Activities that historically are guilty of not returning the retrograde or other assets of AMC activities would no longer be able to keep the assets of another activity within their operation without AMC's knowledge. Enabling operations to monitor the location of their assets translates into a reduction in the extra inventory of the assets they are required to purchase in order to perform their cargo handling duties.⁷¹

c. Yard Management

Depending on the volume of incoming cargo activity at a given aerial port the management of the incoming delivery vehicles can be a labor and asset intensive operation. Mismanagement of the exterior operations of a cargo receiving and processing facility can be the source of significant bottlenecks in the supply chain. An APOE is not immune to this concern. Personnel are dedicated to determining the contents of an arriving truck and deciding where an arriving delivery truck is to be offloaded. Utilizing RFID tags on arriving trucks by listing the contents of the truck along with other important logistical information such as final destination, weight, special handling characteristics would allow a worker at a terminal to relay information to the arriving truck via digital signs or radio concerning which dock to use and estimated time until the dock is available should they all be in use.⁷²

Another application of this use of RFID tags would be the ability of APOE cargo processing personnel to be alerted to the arrival of incoming shipments and their contents. This could ensure that any preparations particular to each type of cargo (ammunition, specific destinations, heavy weight, hazardous material, etc.), could be immediately made before the arrival of the truck at the docking station.

The value gained in using RFID for these two applications is an increase in the speed with which cargo can be in-checked into the APOEs' GATES system.

⁷¹ Ibid.

⁷² Ibid.

Relieving this potential receiving bottleneck could, during contingencies and other heavy cargo inflow days, create enough additional efficiency to allow more cargo to in-checked and subsequently put onto aircraft than could be accomplished without RFID.

d. Expedited Customs Processes

End users stationed overseas are often victims of inefficient customs procedures of the countries in which they operate. The process of breaking down pallets, opening boxes and verifying the contents against a manifest can negate any efficiency gained through upstream supply chain efficiencies. Being able to identify the contents of a piece of cargo using RFID without having to physically inspect could significantly expedite the customs process for AMC's end user customers.⁷³ In doing so, the customers are able to get their cargo faster and have less of a tendency to reorder based on lack of visibility of parts that are in customs facilities without RFID interrogators and readers. In order to implement a process such as this, funds would likely have to be allocated to procure and install sufficient RFID infrastructure at key customs operations overseas. Additionally, agreements and training would have to be arranged in order to create and efficiently run this scenario. The costs of doing so, however, would be insignificant compared to the cost savings in reorders and expedited operational readiness achieved through a speedier customs process.

⁷³ Ibid.

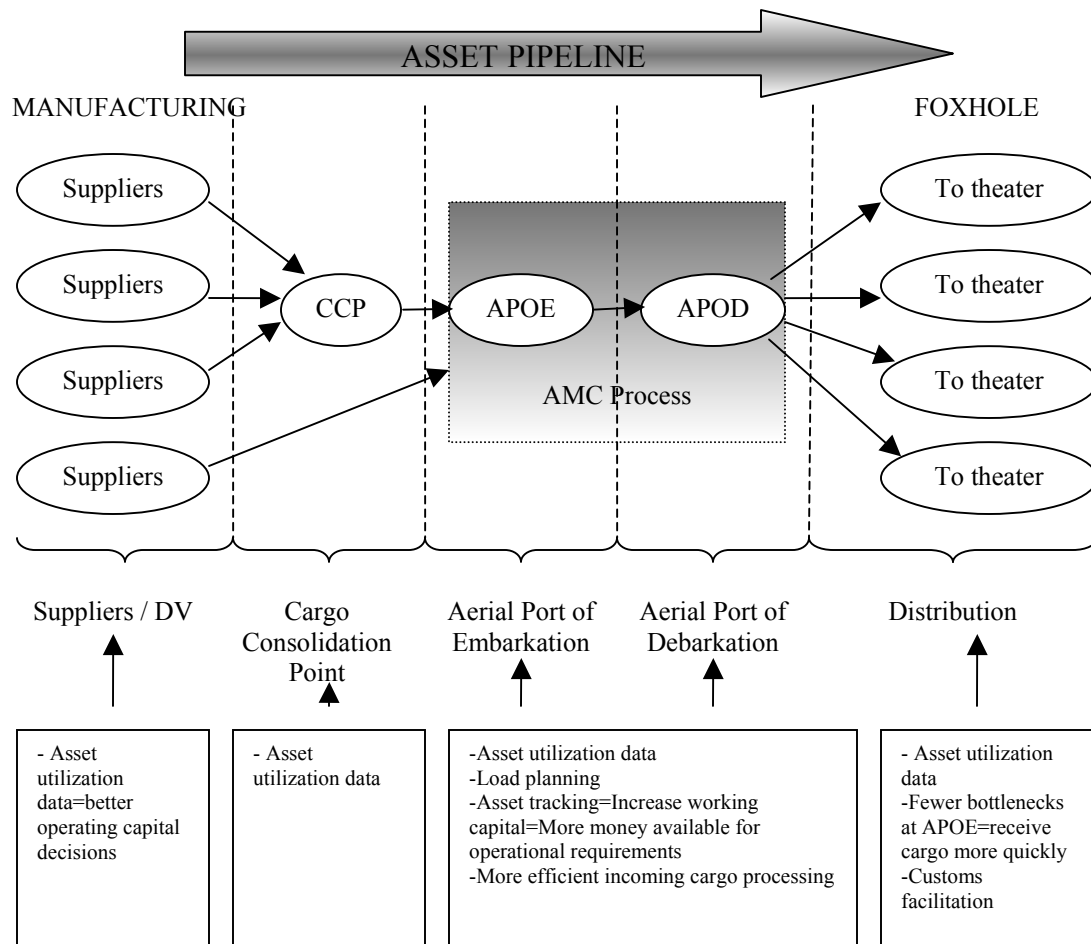


Figure 11. RFID Value in Transportation Processes

4. Maintenance

Maintenance is an activity that consumes large amounts of time for most operational activities. The scheduling and recording of maintenance can take as long or longer than the maintenance itself. An RFID tag placed upon a vehicle could serve to identify time based maintenance needs. For example, if an engine is to have its oil changed every three months, then a truck not having been serviced for three months would, in passing by an interrogator and reader, notify maintenance personnel via the RFID system that maintenance needs to be performed on the vehicle. Once the vehicle arrived at the service area (or service arrives at the vehicle), the tag could be pinged again to make a record in the database that the truck arrived for service. Once the service is

complete, a record of service is burned onto the engine's RFID tag and the vehicle departs the service area (or, if in the field, the technician uses a handheld reader/burner that record that the vehicle is operationally available). Using this process, not only has the vehicle been serviced with significantly less paperwork involved, a record has also been made of the time it took the technicians to complete the service.

In addition, the servicing facility's capacity utilization is recorded by interrogating the RFID tags on each of the vehicles in the facility at any given time. This could allow for more efficient asset and labor utilization as well as better capital budget decisions. Underperforming activities could be targeted for additional training or process improvements. Vehicles that find themselves registering more pings in the repair facility than is required or expected could be easily singled out with less research and subsequently overhauled or replaced. Another benefit to the unit to whom the vehicle belongs would be the ability to follow the progress of the service in order to make better operational decisions based on improved visibility of its assets in maintenance or repair.⁷⁴

More efficient maintenance tracking and performance can have significant positive impacts on AMC. First, personnel whose primary job is to track the maintenance can have their workload reduced and can concentrate on activities that add value to the operation. Second, having a more efficient maintenance operation leads to having fewer vehicles in maintenance or awaiting maintenance at any given time. This is a very cost efficient way of increasing operational availability of assets as opposed to simply buying more assets to overcome an inefficient maintenance system. Figure 12 outlines these and other potential value that could be gained through RFID implementation in maintenance activities of AMC. Included in the diagram at the supplier link is the ability of a spare parts supplier to monitor the maintenance activity of an aerial port in order to be able to monitor potential demand for parts downstream before the order for the part is placed. This capability would require a robust RFID infrastructure as well as the ability of the tag to monitor failures in a piece of gear. Such capabilities are years away, but the supply chain implications of this scenario could result in huge savings in spare parts inventory and operational availability with a given number of assets.

⁷⁴ Ibid.

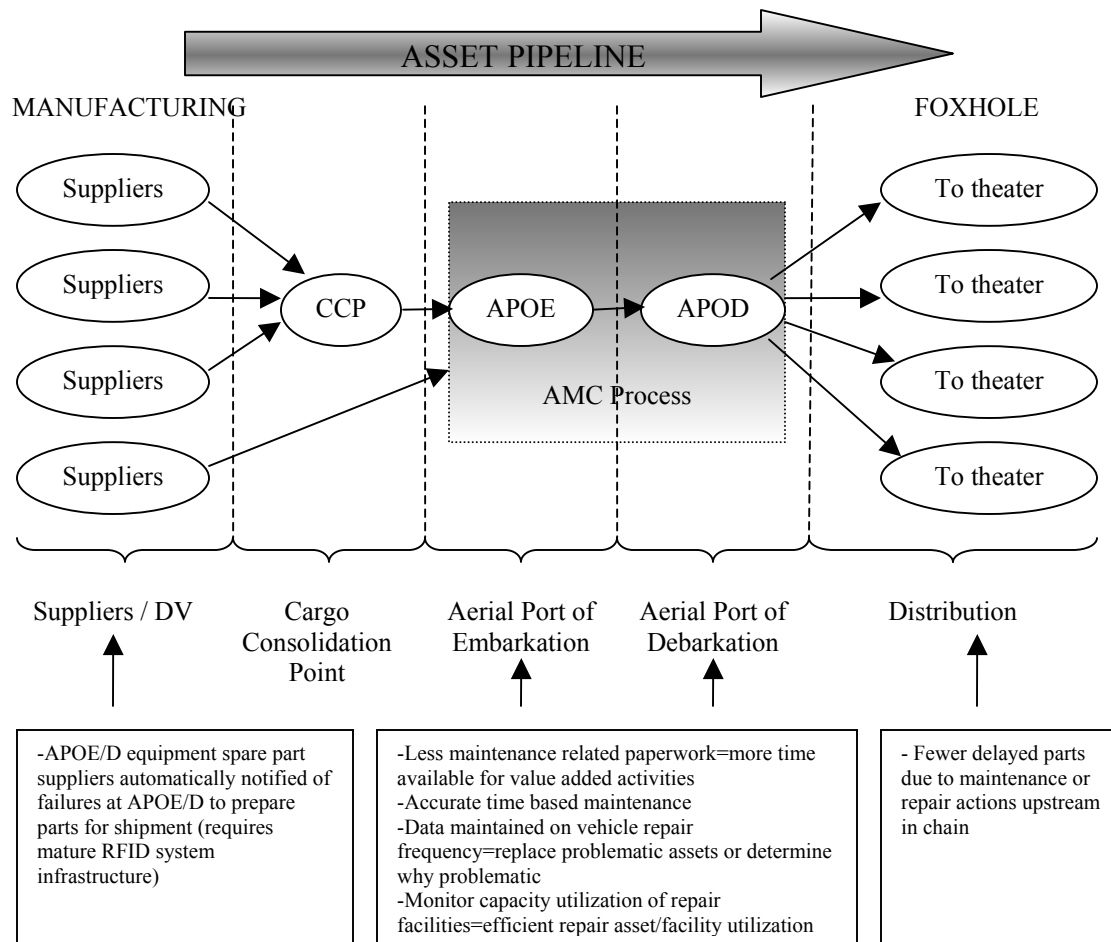


Figure 12. RFID Value in Maintenance Processes

5. Disposal

The final element of the Acting USD(AT&L) memo states that RFID is to be incorporated into the Services' material disposal processes, mentioning specifically hazardous material (hazmat). RFID based management of hazardous material is a very near term possibility. For consumable hazardous material, expiration dates can be placed on a tag by the supplier or manufacturer and can alert the RFID system when its specific date of expiration passes so the item can be disposed of properly. For other types of non-consumable or used hazardous material being transported through the DoD transportation system, tags affixed to the particular item can serve multiple purposes.

First, for a cargo handling facility such as an aerial port, an RFID tag on piece of cargo indicating that it is hazmat along with any associated unique handling instructions (general instructions and location of the hazmat could be printed out as soon as the hazmat passed the interrogator) could alert handling personnel as soon as it enters the aforementioned “yard” instead of waiting for it to reach the dock. Doing so would allow personnel to begin preparations for its proper handling before it is unloaded. Time saved by preparing proactively versus reactively means faster movement down (or back up in some cases) the chain and faster TAT for transportation asset (commercial or DoD) delivering the cargo.

Second, the simple point-to-point visibility that an RFID tag can provide HAZMAT, as for any piece of cargo, could allow logisticians to quickly trace the route already traveled by the HAZMAT should the situation warrant. Doing so could help identify activities improperly preparing hazmat for transport as well as alerting commands through which the hazmat has passed should any exposure issues be detected by the shipping entity.

Tracking HAZMAT with RFID tags could greatly reduce the paperwork associated with this administratively burdensome task, one that adds very little value to an operation. The ability to locate, on demand and in real time, every piece of HAZMAT within an organization could serve many purposes. First, it would provide inventory data on how many pieces of HAZMAT are within the walls of the activity. Second, it could identify HAZMAT that is not returned to its proper storage location after use. Third, HAZMAT disposed of improperly would trigger an alert so that personnel could place the HAZMAT in the proper storage area.

For example, at the end of the workday at the aerial port, a worker has forgotten an empty can of flammable material being used on work in a room with heavy equipment. An instantaneous RFID interrogation (a muster of sorts) throughout the warehouse would identify the piece of HAZMAT still out of the issue room and provide its current location. The person retrieving the empty HAZMAT container would attempt to throw the can in a non-hazmat regular trash can on which a reader is affixed. Sensing that the container is present and should not be in the can, another alert is given

identifying where the can has been improperly discarded. The can could be easily located and then disposed of in a proper manner. The record of the proper disposal could be subsequently recorded by another reader in the disposal area. The can is subsequently removed from the books and another one could be automatically ordered.

The third scenario may be very forward looking, but with the labeling of each piece of HAZMAT by the manufacturer, it is not an unrealistic goal. It is the mentality that commands should take in the years to come during their implementation of their respective RFID infrastructures and processes. Figure 13 outlines some of the potential value associated with RFID use in Material Disposal Processes.

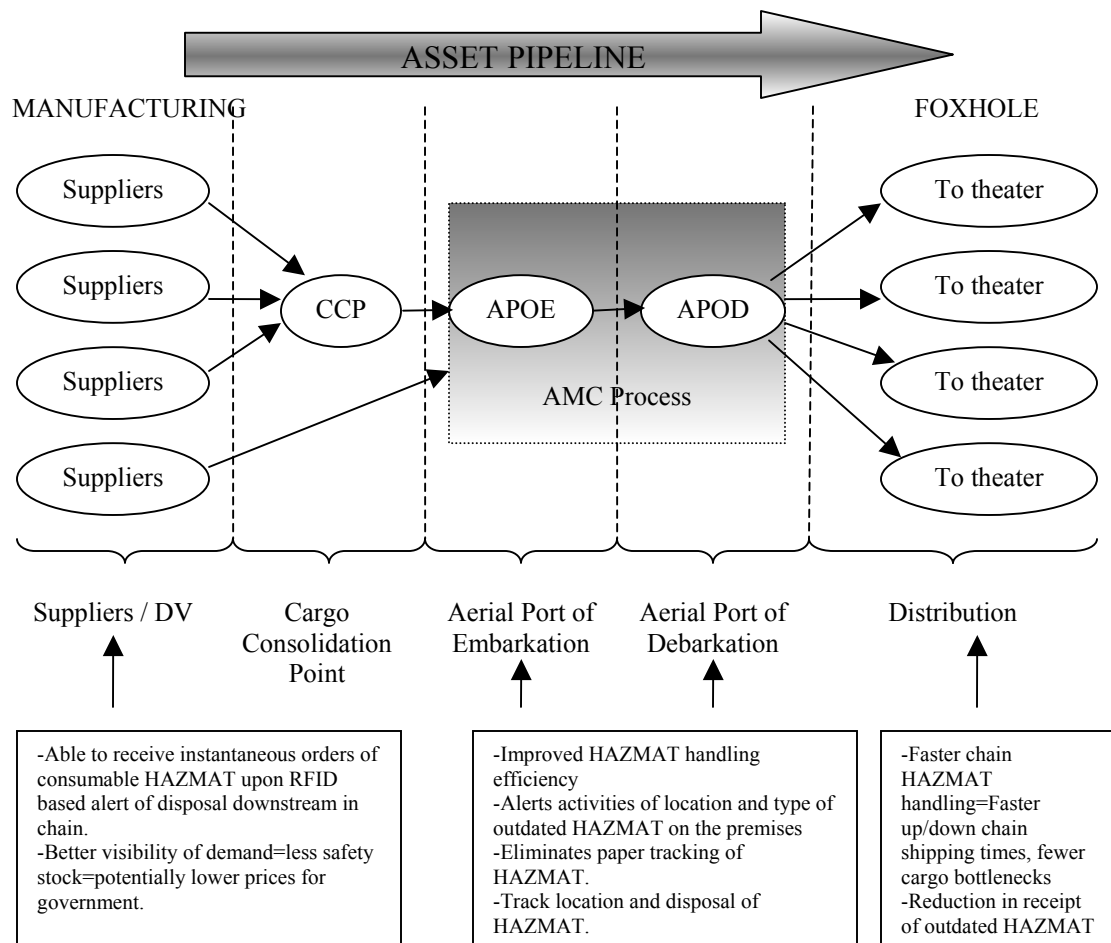


Figure 13. RFID Value in Material Disposal Processes

6. Other Potential Near-Term Value Adding Uses of RFID

The aforementioned applications of RFID are literally a fraction of the capabilities that a robust, standardized, user-friendly and trusted RFID system could bring to the DoD logistics arena. The Acting USD(AT&L) memo of 2 October 2003 is understandably vague in its description of how RFID is to be implemented and for what purposes it is to be used. Many uses of the technology can be imagined that are would not necessarily fit well into the categories listed in the Acting USD(AT&L)'s memo. Some of these applications could be among the first ones to be implemented in a DoD RFID system. Reducing cargo shrink (by theft or other means) through RFID tagging as well as eliminating outdated/expired material and food would be of great value to inventory, transportation and operations activities. The overall value that applications such as these could bring to all entities in the chain would have positive financial and operational benefits for all chain members, not just those receiving the immediate benefit. It is crucial that, when thinking of how to implement RFID into an operation, that the planners think in terms of how best to globally optimize, that is, how can all members of the chain benefit. Specific recommendations on how this new way of thinking can be implemented in the supply chain are discussed in Chapter 8.

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VIII. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

Based on interviews with personnel at USTRANSCOM, HQAMC including TACC and Fusion Cell personnel, the DoD Logistics AIT Office at Scott AFB, and Travis AFB AMC aerial port workers, it is the finding of the project team that HQAMC and its worldwide network of aerial ports are currently receiving very little value from RFID. The team's research found that the use of RFID in aerial ports to assist with frustrated cargo processing is the only tangible value being derived from RFID use within AMC operations. Furthermore, the team did not have the impression of enthusiasm on the part of AMC personnel for the expanded implementation of RFID. Both of these observations led the project team to the conclusion that large scale RFID implementation within AMC beyond the mandatory tagging of CENTCOM bound pallets for ITV purposes will be difficult, but not impossible. The mandated implementation directed by the memo from the Acting Under Secretary of Defense (AT&L) will serve as a strong push forward. The question is in which direction.

The project team concluded that there are myriad reasons for RFID's insignificant role in AMC operations despite the fact that many of the cargo pallets coming in and leaving its aerial ports have RFID tags affixed to them. The first reason is GATES' success in enabling AMC personnel to know where pallets and specific pieces of cargo are within its APOE-APOD portion of the supply chain create a significant entry barrier for RFID. The personnel interviewed by the project team voiced unanimous support for GATES and its cargo tracking capabilities. These included personnel at USTRANSCOM, AMC TACC and Fusion Cell at Scott AFB, the DoD Logistics AIT Office at Scott AFB and AMC's aerial port at Travis AFB. The support for RFID from the same personnel ranged from strong advocacy to strong resistance, with many holding the latter position. The primary concern among the personnel interviewed was identifying any additional value that RFID implementation would have for AMC. GATES' capabilities have allowed that system to develop strong roots within AMC's operational culture and it is the opinion of the project team that RFID is viewed as a threat rather than a complement to its capabilities. The team got the impression that there

is a mentality within AMC that RFID and GATES are mutually exclusive entities. This is not the case. RFID can be a complementing AIT to GATES and other AISs in the DoD supply chain.

The second reason that AMC receives little value from RFID is that there is a lack of widespread Service knowledge concerning the optimizing of supply chains, with complete global (DoD) supply chain optimization among all chain members being the ultimate goal. The term ITV was often used by interviewees; ITV and RFID are also mentioned in numerous articles from various sources from entities throughout DoD. Apart from glorifying the point-to-point cargo tracking benefits of ITV (which GATES does in the APOE/D link), there appears to be a lack of understanding of what RFID can do for a supply chain.

The knowledge of how to optimize a supply chain is difficult to understand without formal education, and even then it remains a daunting subject. To the knowledge of the project team, outside of various formal undergraduate and graduate educational programs, there exists no formal In-Service training for Enlisted or Officer personnel in the management of a supply chain. This renders it difficult for personnel to understand the possibilities of RFID enhanced supply chain management as well as general supply chain efficiency improvement. Their focus remains within the confines of their operation.

Another reason that AMC might be slow to incorporate RFID into their operations is funding. The aforementioned memo from the Acting Under Secretary of Defense (AT&L) of 2 October 2003 states that “the cost of implementing and operating RFID technology is considered a normal cost of transportation and logistics and as such should be funded through routine Operations and Maintenance or Working Capital Fund processes.”⁷⁵ This could present a budget problem for not only AMC but also other entities paying AMC to ship their cargo as AMC attempts to cover its new RFID overhead through charges to other Air Force entities and the other Services.

USTRANSCOM/AMC will continue to shoulder much of the cost burden for tagging in the near term. This unfortunate situation will result based on the statement in

⁷⁵ Office of the Under Secretary of Defense (AT&L), Radio Frequency Identification (RFID) Policy, Attachment 2, 2 October 2003.

the Acting USD(AT&L)'s memo that "it is the responsibility of the activity at which containers, consolidated shipments, or air pallets are built or reconfigure to procure and operate sufficient quantities of RFID equipment to support the operations."⁷⁶ Until RFID tags are affixed to every item before they arrive at the APOE (mandated to occur by January 2005), AMC will be responsible for fulfilling this requirement for untagged cargo arriving at its aerial ports.

Convincing AMC leaders and operators that RFID could add significant value to their daily operations beyond what GATES currently provides will be a difficult task. It may not suffice to simply identify areas within AMC, as this project has endeavored to accomplish, where RFID could add value. Certain DoD managers and operators will demand quantitative data that proves RFID is beneficial both to managers' respective budgets in the form of savings and to warfighters in the form of a more efficient, and thus faster, supply chain. Providing this data is no simple task. There is simply not an abundance of this type of cost savings or effectiveness data because RFID is such a new application of AIT in supply chain management. Until small scale pilots can be completed and cost benefit analyses of the results can be completed, quantifying value gained from RFID is an educated guessing game at best. This scenario is outlined in Figure 14.

⁷⁶ Ibid.

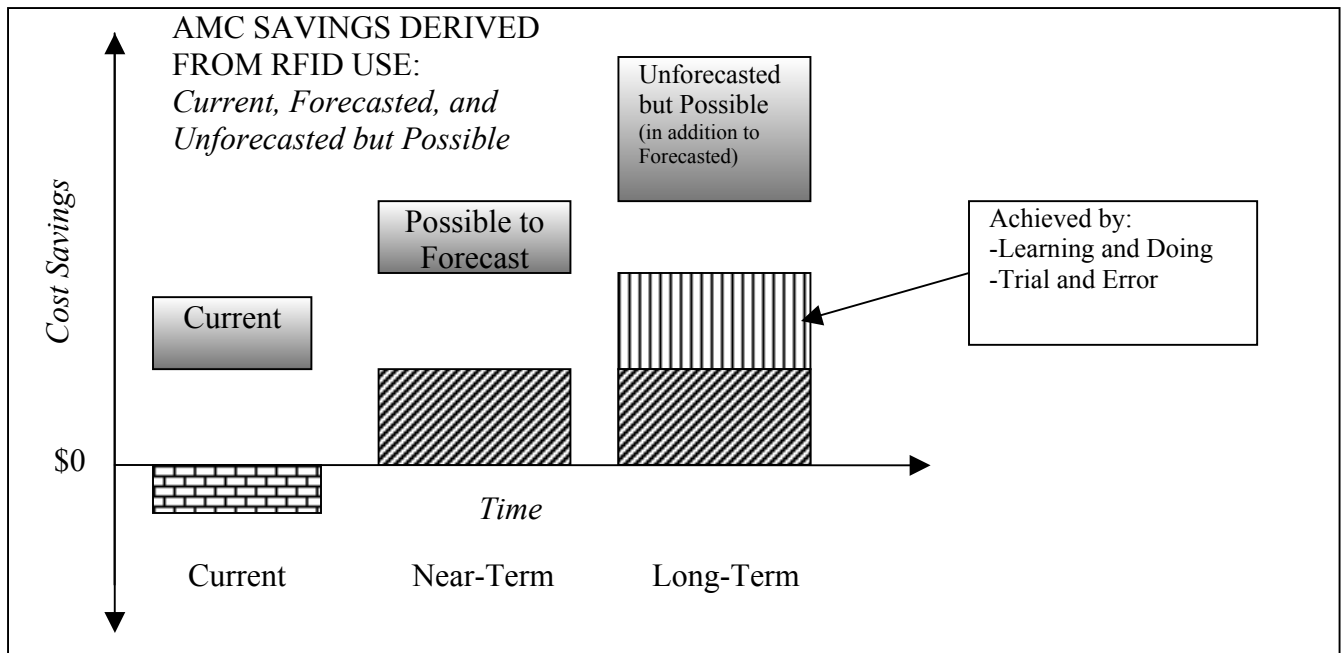


Figure 14. AMC Savings Derived From RFID Use

The current savings derived from RFID use in its operations are arguably nothing. In fact, as figure 14 shows, it is likely a negative figure, meaning that RFID tagging costs AMC more than RFID saves in efficiency. The second stage of realized forecasted savings could represent the savings derived from the implementation of some of the ideas mentioned in this project, as well as other applications identified by DoD and Commercial RFID and logistics experts. This number is difficult to quantify, but it is reasonable to assume that it exists. The last column represents not only the forecasted savings from the second column, but also savings resulting from “learning by doing” and “trial and error” of AMC personnel as they grapple with the RFID implementation and identify new applications of RFID that had not been previously identified in the original implementation plan. This forecast relies heavily on the experience and ability of AMC’s Enlisted aerial port operators and their freedom to adapt RFID to new applications as they become apparent.

For example, someone may decide that RFID could be helpful in identifying heavy loads in trucks arriving at aerial ports. Being alerted to this information as soon as the truck passes the RFID interrogator at a specific aerial port’s entrance could give the port’s personnel time to ready the equipment and personnel necessary to be able to

quickly offload the heavy piece of cargo without the normal delay of waiting for heavy lift equipment after looking inside the truck. Being able to match the equipment to the truck before the truck opens its doors could pay huge dividends in AMC's management of their cargo moving assets. This is but one example of the many RFID applications that might not be evident at the outset of implementation, but that could reap huge savings over time as they become more apparent and utilized.

B. RECOMMENDATIONS

Based on the project team's research of RFID implementation into commercial companies and the findings of the researchers at the Auto-ID Center at the Massachusetts Institute of Technology, it is the recommendation of the project team that AMC expand its use of RFID within its own internal processes in order to be able to maximize value from implementation of DoD suppliers using passive RFID tags on the "lowest possible piece part/case/pallet packaging" no later than January 2005.⁷⁷ At a minimum, having the infrastructure within the walls of AMC aerial ports to support RFID enhanced management of AMC internal processes will lead to isolated efficiency gains within AMC. If, however, RFID is able to reach its full potential throughout the supply chain through successful mandated tagging and a robust RFID network, the benefits will be significant.

Broad implementation of RFID can only occur, however, if every link in the chain goes about implementing RFID infrastructure based on a standard plan developed through strong business case studies and carefully conducted and thoroughly analyzed pilots. The timeline in the Acting USD(AT&L)'s memo is very aggressive, calling for the results of the initial RFID projects to be completed and analyzed no later than May 2004, with final "business rules" to be based on the results of the initial RFID projects. The project team is concerned that this timeline does not allow for the widespread lack of knowledge throughout the supply chain of how that chain can be globally optimized to the extent possible within the constraints of knowledge, time, and budgets. It is the hope of the project team that in lieu of a rush to implement a stove piped expansion RFID that the time will be taken to follow a joint, methodical approach. The process must be jointly

⁷⁷ Office of the Under Secretary of Defense (AT&L), Radio Frequency Identification (RFID) Policy, 2 October 2003.

pursued by all of the Services, because all of the Services stand to benefit or lose from this new process. Thus, they are all stakeholders in RFID implementation and should have equal interest in its implementation.

The following is the project team's recommendation for pursuing RFID implementation within AMC. The team believes that the using the Auto-ID Center's format for recommendations can equally serve all members of the DoD supply chain. As previously mentioned, the recommendations should be pursued using the inputs of all Services.⁷⁸

- 1. Target Value**

- a. Form a Joint RFID Supply Chain Implementation Committee***

Representatives from all of the stakeholders in DoD RFID implementation, including USTRANSCOM, AMC, DLA, operational end users, Service logistics experts and C2 elements from each Service, as well as private sector logisticians with RFID experience, supply chain experts, commercial direct vendors and RFID technical advisors (Savi) should be formed into a Joint RFID Supply Chain Implementation Committee (JRSCIC). The committee's job should be to, outside of the constraints of current DoD logistics regulations, determine how to best globally optimize the DoD supply chain. The goal in this task should be to identify how the actions of each link of the supply chain affect the operations of every other supply chain link. This will take some time, as no evidence of this sort of research having been done before was found by the project team.

Also, the learning that has taken place and data that has been gathered involving RFID use in providing simple ITV for the end user is woefully insufficient to use as a base for large scale RFID implementation. Instead, it is crucial that the supply chain be meticulously understood in order to be able to create a pilot and eventual implementation that is logical and useful for all members of the chain, a goal that will eventually create value in the form of faster receipt of parts to the most important stakeholder, the war fighter. Once the supply chain is understood in the sense of how each entity's actions affect the others, the study of how to implement RFID can begin.

⁷⁸ Michael Boushka, Lyle Ginsburg, et.al., "The Value of Auto-ID Technology in Freight Transportation," Auto-ID Center, Cambridge, MA, 1 November 2002.

b. Value Targeting

After the intricacies of the supply chain have been identified, areas within the chain must be identified as having the potential to receive the most value or benefit from RFID implementation. These areas of value are included in the second column of Figure 14, those that can be identified and whose cost savings can be roughly forecasted. In the example of AMC, it may be determined by the Joint Committee, based on the inputs of the AMC representatives, that the inchecking of cargo into GATES should be one of the targeted areas for an RFID implementation pilot. Inevitably there will be many potential value-adding applications that could be identified, but in consideration of the scale of the pilot, cannot be included. These applications can be implemented later after the results of the pilot have been analyzed and the full-scale implementation begins. The goal in value targeting should simply be to identify specific actions within each component of the supply chain that can be pilot tested, in series, at the same time, in order to gather analyzable data that will provide maximum benefit in creating and implementing a large scale RFID infrastructure throughout the supply chain. This can only be done through a Joint effort. Otherwise, the pilot will likely provide results that are limited in their utility and will create cascading negative effects that will manifest themselves in the later actual RFID implementation.

2. Align Opportunities

a. Sharing the Burden

Each of the stakeholders in the Joint RFID Supply Chain Implementation Committee (JRSCIC) take the every area of potential value identified in the value targeting and determine, based on ability to pay, how to scale the pilot. It is not logical to create a pilot with an end goal of being able to implement a certain type of infrastructure if the respective entities do not have the budget to pay for it. Although the funding of RFID is outside the scope of this project, it is the recommendation of the project team that cost sharing among the Services should be carefully considered when deciding upon the final infrastructure to implement. Army funds should be considered to alleviate Air Force RFID infrastructure development if it is determined by the JRSCIC that the Army

benefits from RFID use are greater than those of the Air Force. Cost burden sharing models will have to be developed and will inevitably change as the applications of RFID evolve.

3. Build Pilots for Testing and Evaluation

The Auto-ID Center's recommendation of building a "pilot application to test and refine hypotheses about benefits, costs and work processes after implementation" is a logical and crucial step in creating a solid foundation for widespread RFID implementation into the DoD supply chain.⁷⁹ The pilot should be created based on the findings of the JRSCIC. Conducting this pilot will certainly pay enormous dividends in efforts to "improve processes and to identify [additional] requirements for implementation and [subsequent] integration into legacy applications."⁸⁰ Uncovering and resolving issues that surface during well-conceived pilots can, as the Auto-ID Center states, provide "insights into issues or additional ways that specific operations and processes can be improved."⁸¹ Implementing hastily planned pilots that fail to take into consideration the concerns of stakeholders and fail to properly include the intricacies and relationships of the DoD's supply chain will only increase the frustration and costs of future RFID implementation.

4. Integrate RFID with Legacy AISs

Careful consideration must be made with respect to how RFID can be incorporated into DoD's myriad legacy AISs. These AISs, no matter how stove piped, were conceived and implemented with significant effort on the part of DoD and the contractors and military entities who wrote the programs. As mentioned previously, their utility does not, in most cases, diminish with RFID implementation. RFID should be perceived as a utility augmentation AIT for these legacy AISs. To this end, efforts to determine how RFID can be used to supplement these technologies and more importantly how they can be integrated with the AISs should begin immediately, as this is no small task. In the case of AMC, learning how RFID can be used to incheck material into

⁷⁹ Ibid.

⁸⁰ Ibid.

⁸¹ Ibid.

GATES by the pallet instead of manually scanning the pallet or individual pieces of cargo would be one type of value adding RFID integration application.

5. Modify Regulations, Incentives, and Training

a. Regulations

After the successful completion and analysis of the RFID pilot, every Department of Defense transportation regulation should be studied by the JRSCIC to determine the impacts and necessary regulation changes that RFID implementation will have on the DoD supply chain. This must be done to avoid the inevitable confusion that will arise from the coupling of a new technology with a process largely based on manual effort and outdated forms. The authors acknowledge the wide sweeping nature of this recommendation, but it must be emphasized that RFID, if it can be developed into a mature, functioning system, will have impacts on a scale not unlike that of the internet. This fact cannot be stressed enough.

b. Incentives

It is often the case within DoD activities during austere budget eras that savings realized by an activity are rewarded by a budget cut. This mentality removes the incentive for activities to pursue cost savings efficiencies. There may be concern among members of the supply chain that any RFID realized savings could result in a subsequent budget cut. This practice has fostered an environment where activities are encouraged to spend all of the money they receive during the fiscal year which is often capped by a spending frenzy at the end of September that results in procurement of items that may or may not be crucial to the activities' respective missions.

A method of rewarding efficiency gains within the supply chain must be created and implemented in order to promote active efforts among the chain's entities in developing new RFID enhanced ways of supporting its own operations as well as those of other chain entities. Money that is generally haphazardly disbursed at the end of the fiscal year, often to those entities who found creative ways to spend their original budgetary allotments, could instead be used as rewards by funding activities for those activities who demonstrated efficiency gains within their own operations and those who helped other supply chain members improve their global optimization efforts through

feedback. This sort of monetary incentive would reduce infighting among claimants for end of the year “plus-ups” and could possibly foster an improved attitude of cooperation.

c. Training

Should DoD decide, based on the results of the pilot, to go forth with a wide scale implementation of RFID into its supply chain, it must immediately adapt its logistics training pipeline for Enlisted and Officers to incorporate new ways of thinking about logistics operations. Supply chain optimization should be emphasized in addition to the logistics operations of each individual Service. This new training will help DoD logistics personnel think clearly about the supply chain as an interconnected system in order to receive the maximum benefit possible from RFID technology as well as their other processes.

This represents a major shift in current logistics thinking. Some may argue that ITV, in itself, is representative of a broader way of thinking about supply chains. The project team would argue that ITV, as many in the DoD supply chain perceive it, is simply another task that must be completed to get the cargo out of the door and down the chain. Cultural change will be needed to instill the importance of the contribution of individual technologies toward the cost-effectiveness of supply chains. Education is the first step in bringing about this change.

6. Broad Scale Implementation

The final recommendation of how best to implement RFID within the DoD supply chain deals with the creation of RFID infrastructure throughout the chain that represents the vision of the JRSCIC, taking into consideration the results of the pilot test. As previously mentioned, the value that the RFID infrastructure model brings to each member of the supply chain should be considered when determining cost burden for each member. The fact that the model’s most significant physical infrastructure may be located in DLA warehouses should not necessarily warrant DLA paying for the entire DLA RFID infrastructure. All beneficiaries should pay a share of the burden. In some cases this will come in the form of additional overhead charges in the prices of material. Regardless of the method chosen for sharing the burden of infrastructure cost, it is important that it be carefully considered during implementation.

The full scale creation of a robust RFID infrastructure, should the mandate of complete passive RFID tagging by January 2005 be fulfilled by DoD's suppliers, will enable efficiencies that will create immeasurable short and long term benefits for DoD. The beauty of such an infrastructure is that, properly conceived and constructed, it will create a fertile ground on which entities within the supply chain can discover and implement new applications of RFID with blinding speed. More importantly, the infrastructure will have the capability to support the growth of RFID as it permeates not only every corner of DoD logistics, but also the daily operations of every entity within DoD from the monitoring of contractor performance to finding lost equipment in an office space. It is for this reason that the recommended JRSCIC, the pilot testing, the new "business rules" and the subsequently agreed upon infrastructure must be so carefully considered before DoD wide implementation.

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